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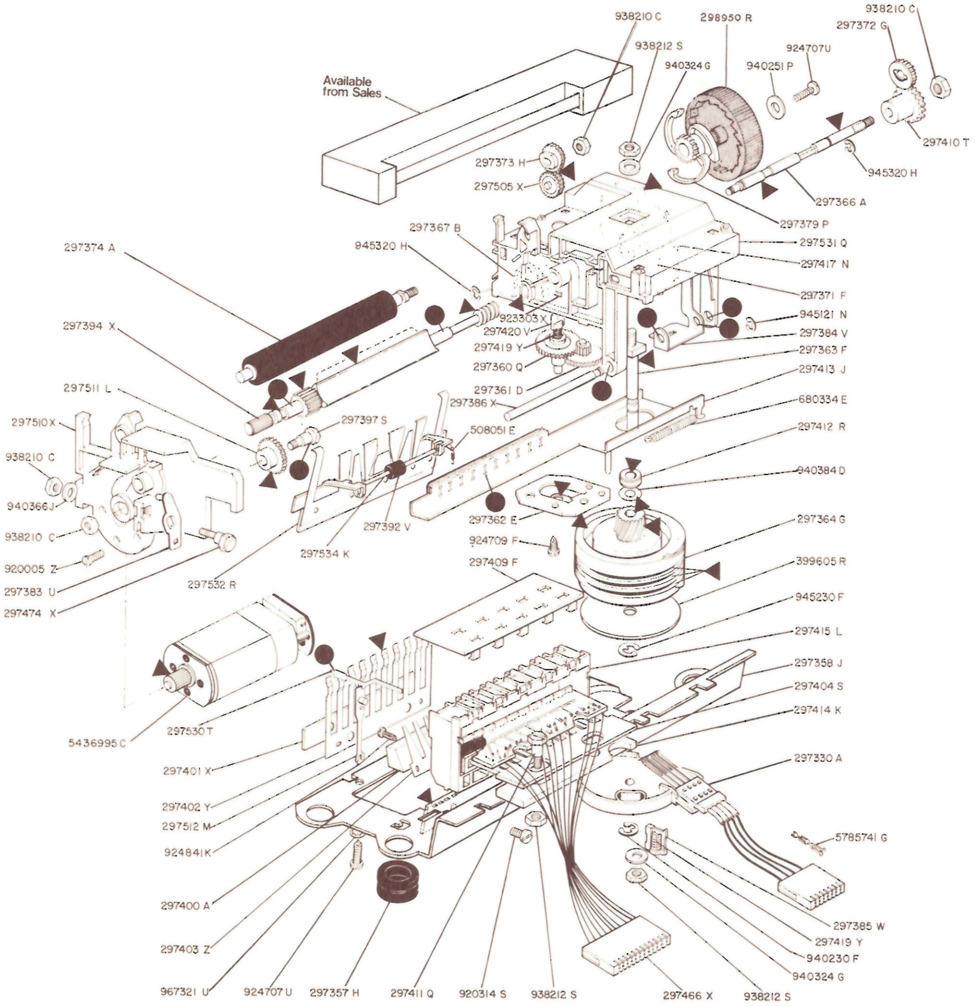

Technical Manual 1L, 2L, R.E.D.

LOGOS 43 PD/ 45 PD

Self Study-Repair Guide-Spare Parts List

STAC CODE: 466.38.2

Printed in U.S.A.

THIS TECHNICAL MANUAL INCLUDES THE FAULT-FINDING GUIDE, SELF-INSTRUCTION, SERVICE AND REPAIR, AND PARTS LISTS.

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GENERAL INFORMATION

MACHINE DIMENSIONS

WIDTH:	10-3/8"	(265 mm)
HEIGHT:	3-5/8"	(92 mm)
DEPTH:	9-3/4"	(248 mm)
WEIGHT:	5 lbs	(2.3-2.4 Kg)

OPERATING VOLTAGES

240V	50/60 Hz
220V	50/60 Hz
125V	50/60 Hz
115V	50/60 Hz
100V	50/60 Hz

SUPPLIES

The machine uses a paper tally roll and a ribbon cartridge, both available from Sales.

PAPER ROLL

WIDTH:	2-3/8"	(60.5 mm)
DIAMETERS:		
	1-7/16"	(40 mm)
	2-3/8"	(60 mm)
	3-9/16"	(90 mm)

RIBBON CARTRIDGE

Self-inking continuous loop.

Housing dimensions are:

WIDTH:	4-5/16"	(98.4 mm)
HEIGHT:	7/16"	(11.6 mm)
DEPTH:	1-1/8"	(28.9 mm)

INTRODUCTION
and
Technical Features

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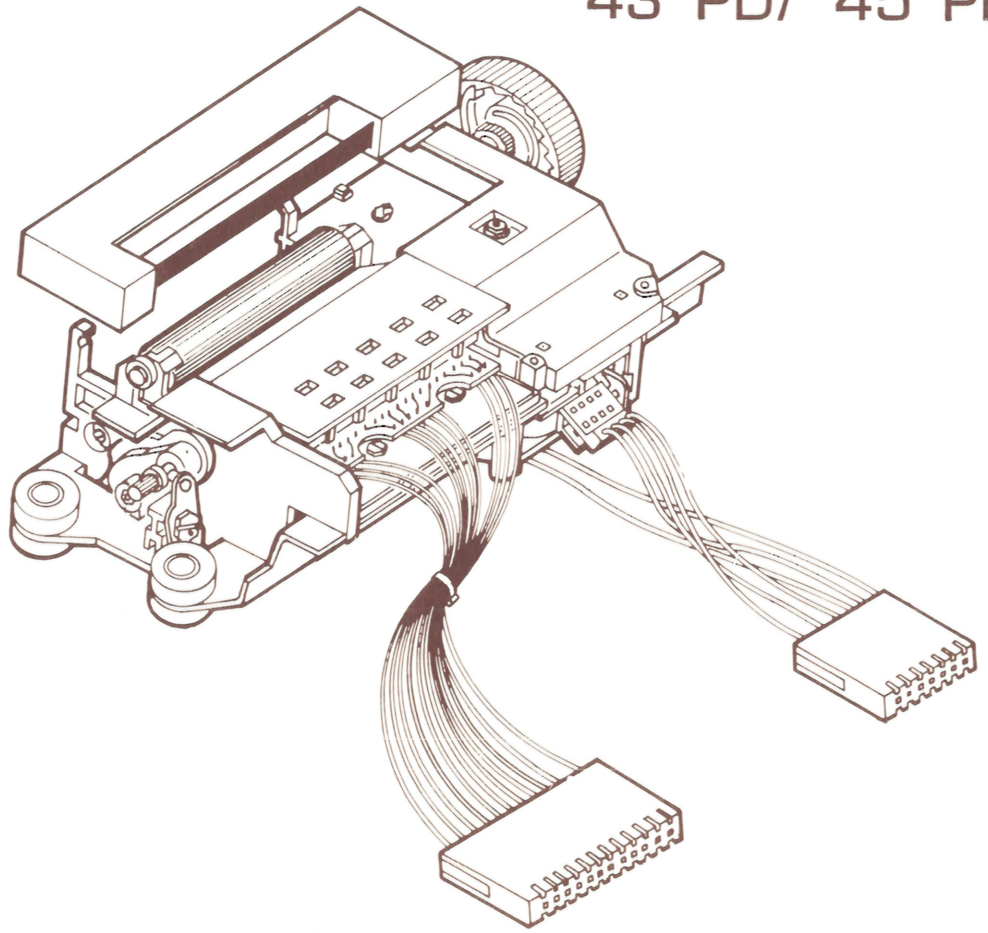
LOGOS
43 PD/ 45 PD



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Serial
Parallel
Printer

The LOGOS 43PD/45PD are application-oriented calculators of the L40 class. The logic board or E.C.U. is designed so that one MOS-LSI device performs the functions of CPU, ROM/RAM and I/O. Also, the same printed circuit board (PC) accepts the additional components for display versions. The E.C.U. includes IC drivers for the motor circuit and the individual coils (or "bobbins") of the Olivetti Serial Parallel Printer, a new approach to dot-matrix printing.

The machines use two PC boards: the E.C.U. itself, and one within the keyboard module. They are removed from the machine as an assembly. The two boards are connected electronically by a laminar spring connector. See fig 2. The keyboard is built upon a mounting plate on which are mounted the SPST keyswitches; the various selector switches; the display module; and the PC board. The calculators are highly modular in design, and are easy to service and repair, when necessary.

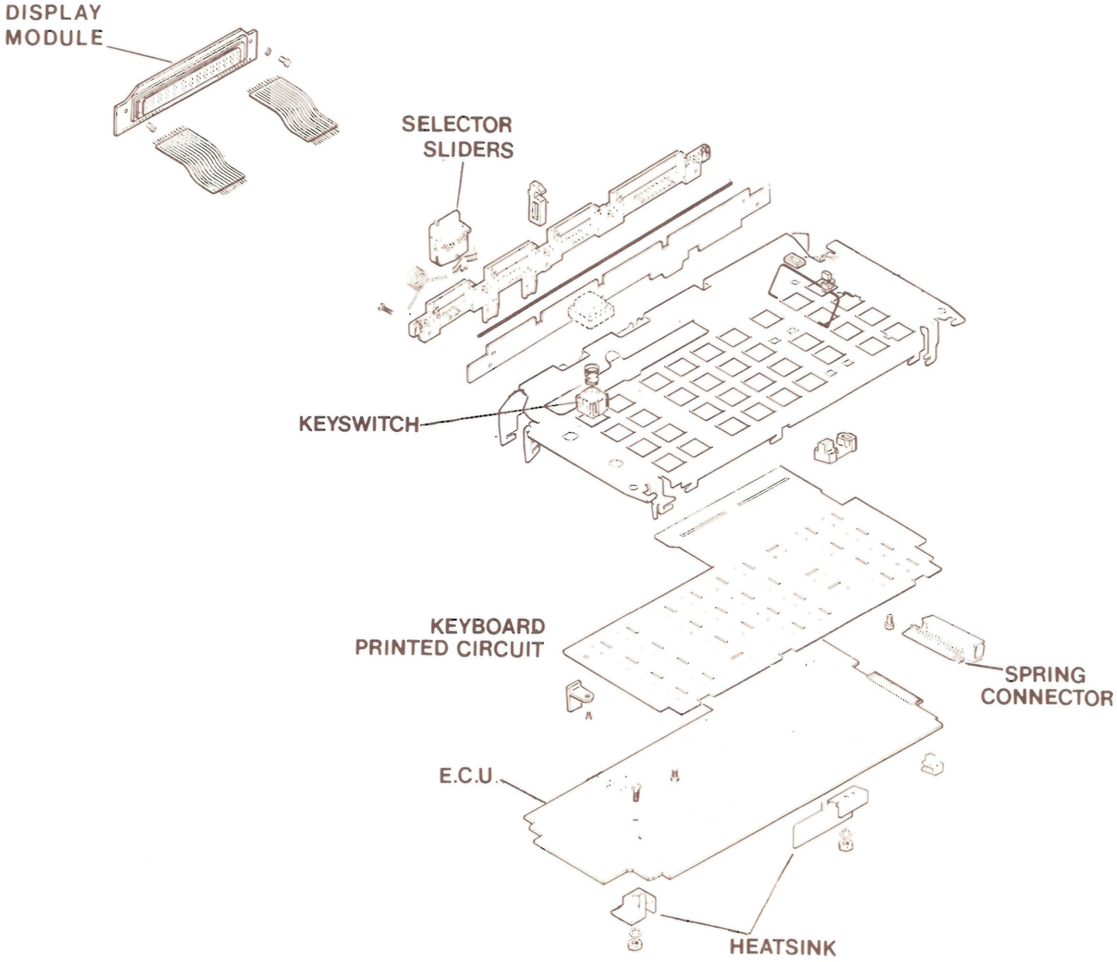


Fig. 2: E.C.U./keyboard module.

MAIN OPERATIONAL FEATURES

1. Each calculator has two working registers, four basic operations in each.
2. Two-key sequence "program" capability.
3. The LOGOS 45PD has additional routine-writing capability for two sequences.
4. Gross Margin, Delta and Parametric Rounding (in addition to R/0 selector).
5. Twelve digit capacity in entry and total, plus decimal point and sign.
6. Constant multiplier or divisor.
7. Memorization of last printed item which can be used for another immediate operation (also called "natural constant").
8. Chain multiplication and division.
9. Preselection of decimals: switch positions are: floating, six, four, two, zero or suppressed decimals, and add-mode; the same selector includes Time In/Time Out ("H") and calendar ("D").

10 Percentage calculation with automatic mark-up or mark-down.

11 Memory calculation (add/ subtract memorization of last printed operand or total).

12 Automatic accumulation.

13 Non-Print if desired; only Non-Add and reset (CE:CA) will print.

14 Five-operation keyboard buffer.

15 Negative multiplication/division and memory functions.

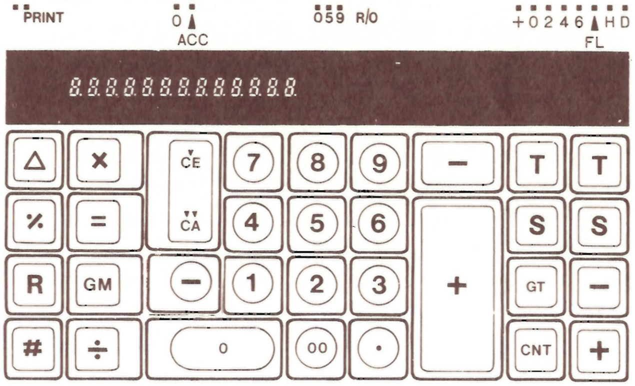
16 Zero suppression.

17 Non-Add.

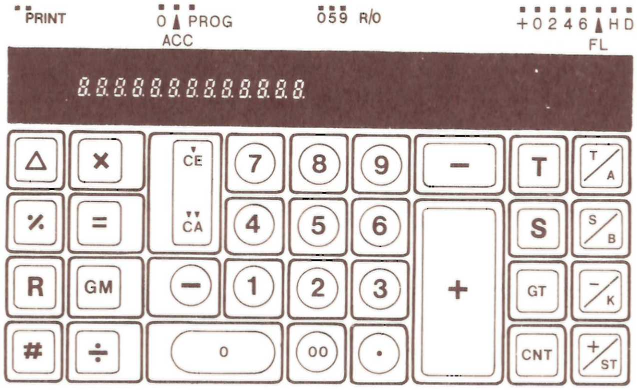
18 Jump totals.

19 Item counter (key command) with automatic averaging.

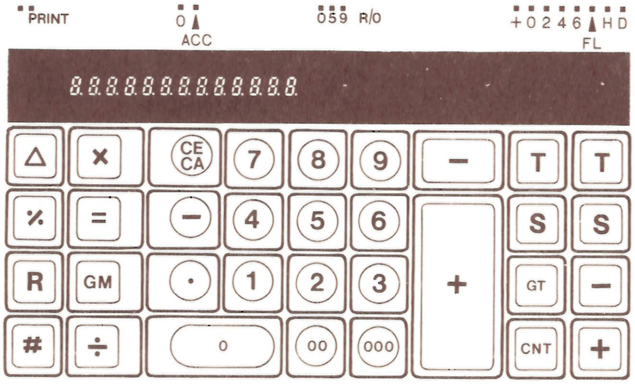
20 Single key performs keyboard clear and machine reset.



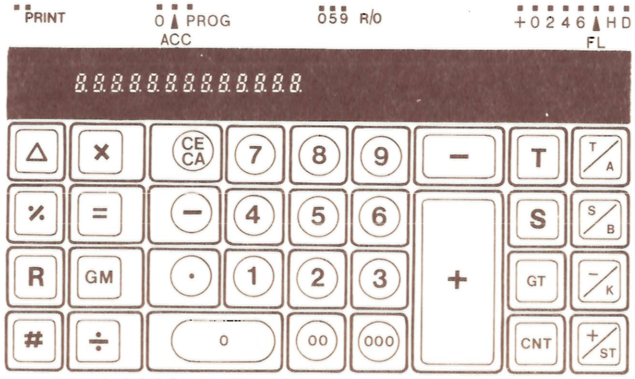
LOGOS 43PD (USA) KEYBOARD



LOGOS 45PD (USA) KEYBOARD



LOGOS 43PD (EUR) KEYBOARD



LOGOS 45PD (EUR) KEYBOARD

THE OLIVETTI SERIAL PARALLEL PRINTER IS AN ELECTRO-MECHANICAL DEVICE THAT USES TEN PRINTING NEEDLES TO PRODUCE DOT-MATRIX CHARACTERS. SEE FIG. 4

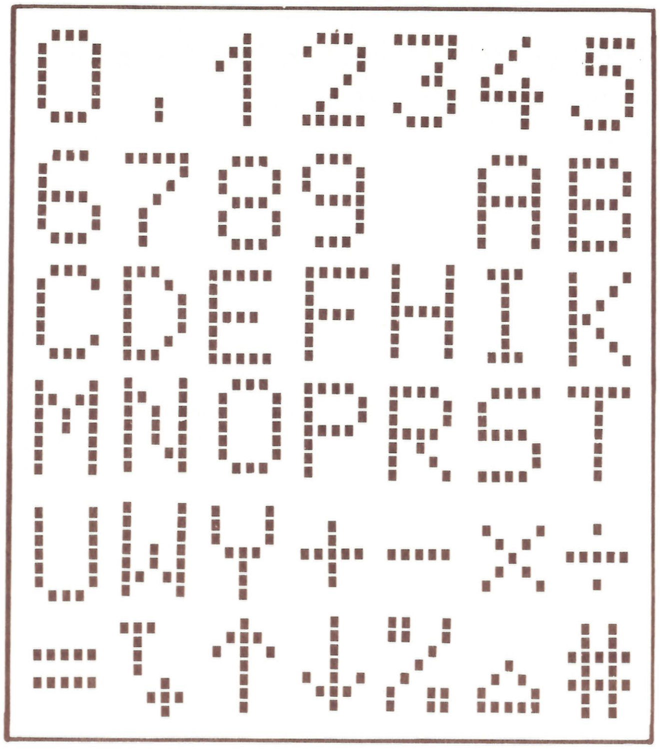


FIG. 4: CHARACTERIZATION

THE PRINTING FIELD IS 20 CHARACTERS WIDE: THREE FOR SYMBOLS; 17 FOR NUMERALS, DECIMAL POINT AND SIGN; SIX FOR MESSAGES TO THE OPERATOR. REFER TO FIG. 5.

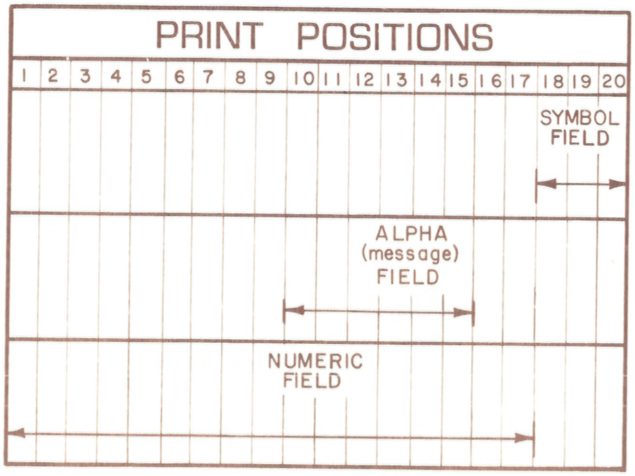


FIG. 5: CHARACTER FIELD

AS THE PLATEN ADVANCES, THE NEEDLES MOVE BACK AND FORTH OVER A TWO-CHARACTER SPAN WHILE STRIKING THE RIBBON IN THE REQUIRED CHARACTER DOT PATTERN. EACH CHARACTER'S MATRIX IS FIVE DOTS WIDE AND SEVEN DOTS HIGH. THE NEEDLES PRINT IN BOTH DIRECTIONS, RIGHT-TO-LEFT AND LEFT-TO-RIGHT, EXCEPT ON THE RETURN OF THE LAST SWEEP WHILE THE PLATEN ADVANCES TO THE NEXT CHARACTER LINE. SEE FIG. 6.

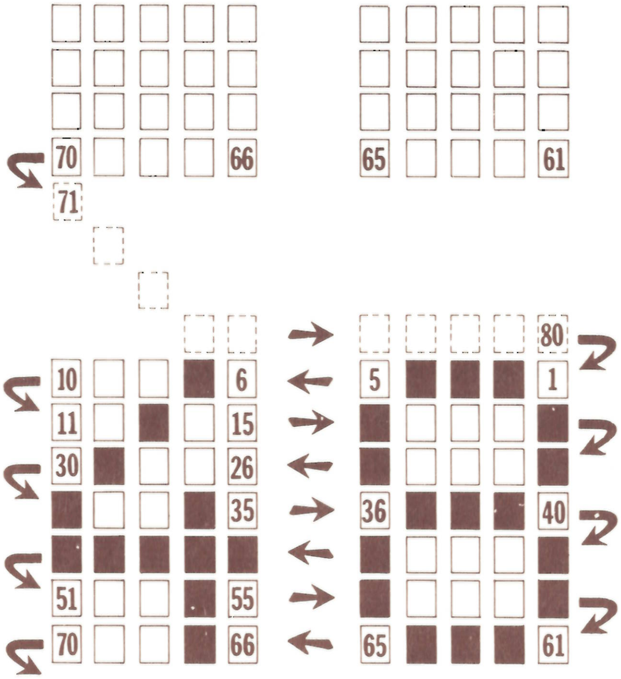


FIG. 6: DOT PROGRESSION

THROUGHOUT A PRINT CYCLE, THE PRINT NEEDLE GUIDE MOVES SIDE-TO-SIDE, THE RESET SHAFT ROTATES, THE PLATEN ADVANCES UPWARD BY ONE-DOT INCREMENTS, AND THE STROBE DISC SENDS TIMED PRINT SIGNALS TO THE E.C.U. FOR SELECTION.

THESE SIMULTANEOUS MOVEMENTS ARE EXPLAINED INDIVIDUALLY.

Prior to printing the entire mechanism is at rest. Rest position for the print needles is achieved when the needle is held away from the platen by its respective anchor. The anchor is held against its respective bobbin by a constant magnetic field produced by the magnetic rubber. See fig. 7.

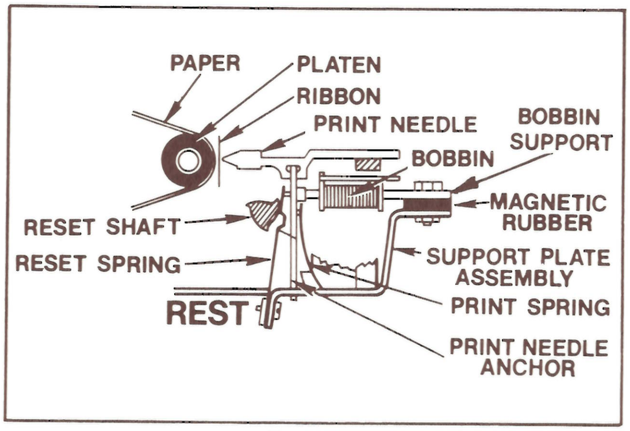


Fig. 7.

When a print cycle begins and the print needle is required to print, the E.C.U. starts the motor and energizes the bobbin which momentarily interrupts the magnetic field holding the print needle anchor. Because the force of the print spring is greater than that of the reset spring, the print needle now strikes the ribbon, causing a dot to appear on the paper. See fig. 8.

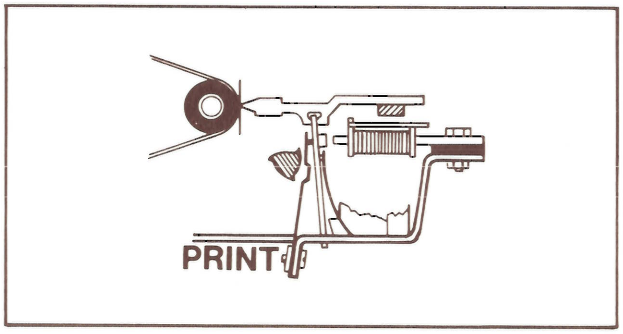


Fig. 8.

The reset shaft is rotating while the motor is running and one of its lobes will push against the reset spring, which moves the anchor and print needle into contact with the bobbin once more. See fig. 9.

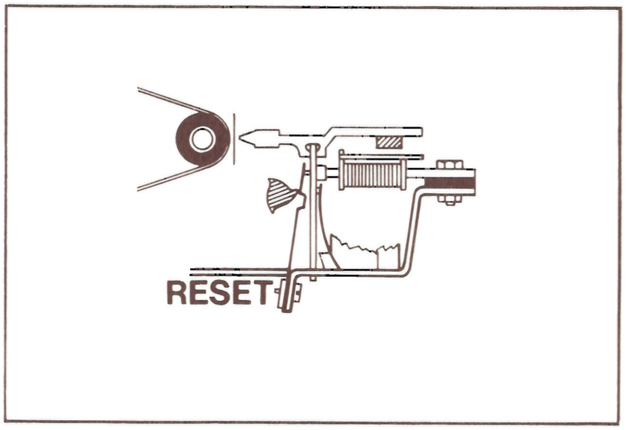


Fig. 9.

The bobbin has since been de-energized by the E.C.U. and the restored magnetic field will hold the anchor and the print needle in place when the lobe of the reset shaft moves away from the reset spring. The needle is immediately ready for another print command from the E.C.U. See fig.10.

For each complete revolution of the reset shaft, a print needle may strike the ribbon three times, producing three dots.

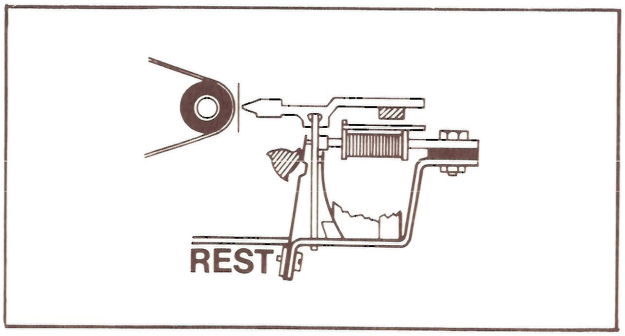


Fig. 10.

PRINT NEEDLE MOVEMENT

DURING PRINTING THE MOTOR DRIVES THE MAIN CONTROL CAM VIA THE RESET SHAFT. AS THE MAIN CONTROL CAM ROTATES, IT MOVES THE NEEDLE GUIDE FROM SIDE TO SIDE BY MEANS OF THE ECCENTRIC TRACK ON THE TOP OF THE MAIN CONTROL CAM AND THE FOLLOWER STUD ON THE NEEDLE GUIDE. THE DISTANCE THAT THE NEEDLE GUIDE MOVES IS APPROXIMATELY THE WIDTH OF A TWO-CHARACTER SPAN ON THE PAPER TAPE.

THIS CONTROL CAM TRACK ACCELERATES THE NEEDLE GUIDE FROM DOT TO DOT WITHIN EACH CHARACTER AND FROM CHARACTER TO CHARACTER. IT ALSO INCLUDES A PAUSE AT EACH END OF A LINE OF DOTS FOR THE PLATEN TO ADVANCE FOR THE NEXT LINE OF DOTS.

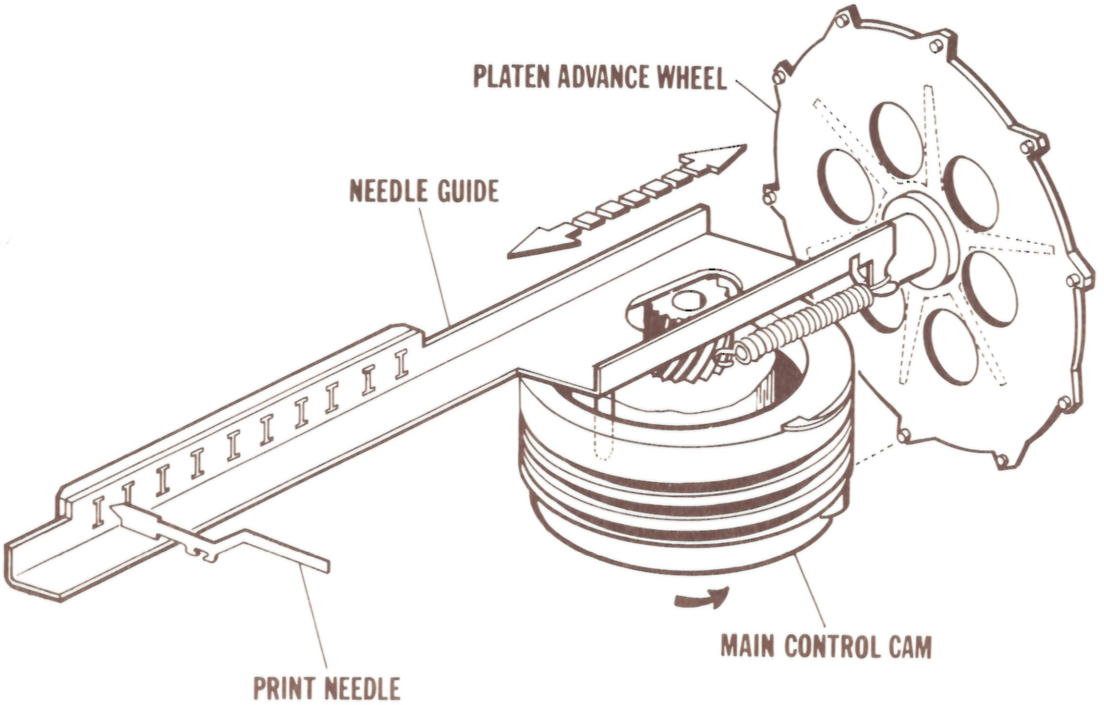


FIG. 11: PRINT NEEDLE GUIDE MOVEMENT

POWER TRAIN

AS THE MOTOR RUNS IT ROTATES THE IDLE GEAR AND THE RESET SHAFT IN THE DIRECTION SHOWN. THE RIGHT SIDE OF THE RESET SHAFT IS A WORM THAT DRIVES THE MAIN CONTROL CAM. THE ROTATION STUDS ON THE PLATEN ADVANCE WHEEL, WHICH FOLLOW THE SLOTS AROUND THE MAIN CONTROL CAM, ARE FORCED UPWARD. THE MOVEMENT OF THE ROTATION STUDS ROTATES THE PLATEN ADVANCE WHEEL COUNTERCLOCKWISE (IN THIS ILLUSTRATION). THE DRIVING LUGS ON THE PLATEN ADVANCE WHEEL CONTACT THE SPIDER SPRING CAUSING IT TO ROTATE IN THE SAME DIRECTION. THE SPIDER SPRING IS KEYED TO THE PAPER FEED GEAR SHAFT, AND IT ALSO ROTATES COUNTERCLOCKWISE. ON THE LEFT END OF THIS SHAFT IS THE PAPER FEED INTERMEDIATE GEAR. VIA THE IDLE GEAR, THE PLATEN IS NOW ROTATING COUNTERCLOCKWISE ALSO. THIS IS HOW THE PRINTER UPSPACES THE PAPER DURING PRINTING AND LINESPACING.

THE SMALL ROTATION OF THE PLATEN DURING PRINTING OCCURS BECAUSE OF A SLIGHT JERKY MOVEMENT OF THE PLATEN ADVANCE WHEEL. THIS MOVEMENT IS CAUSED BY SMALL OFFSETS IN THE SLOT AROUND THE MAIN CONTROL CAM. THE END OF THIS SAME SLOT ALSO CAUSES LINESPACING:
AS ONE ROTATION STUD LEAVES THE UPPER SLOT ON THE MAIN CONTROL CAM, ANOTHER ROTATION STUD ENTERS THE LOWER CAM SLOT. THUS, AT ANY GIVEN MOMENT THERE IS ONE ROTATION STUD IN MESH WITH THE MAIN CONTROL CAM. SEE FIG. 13, PAGE 9.

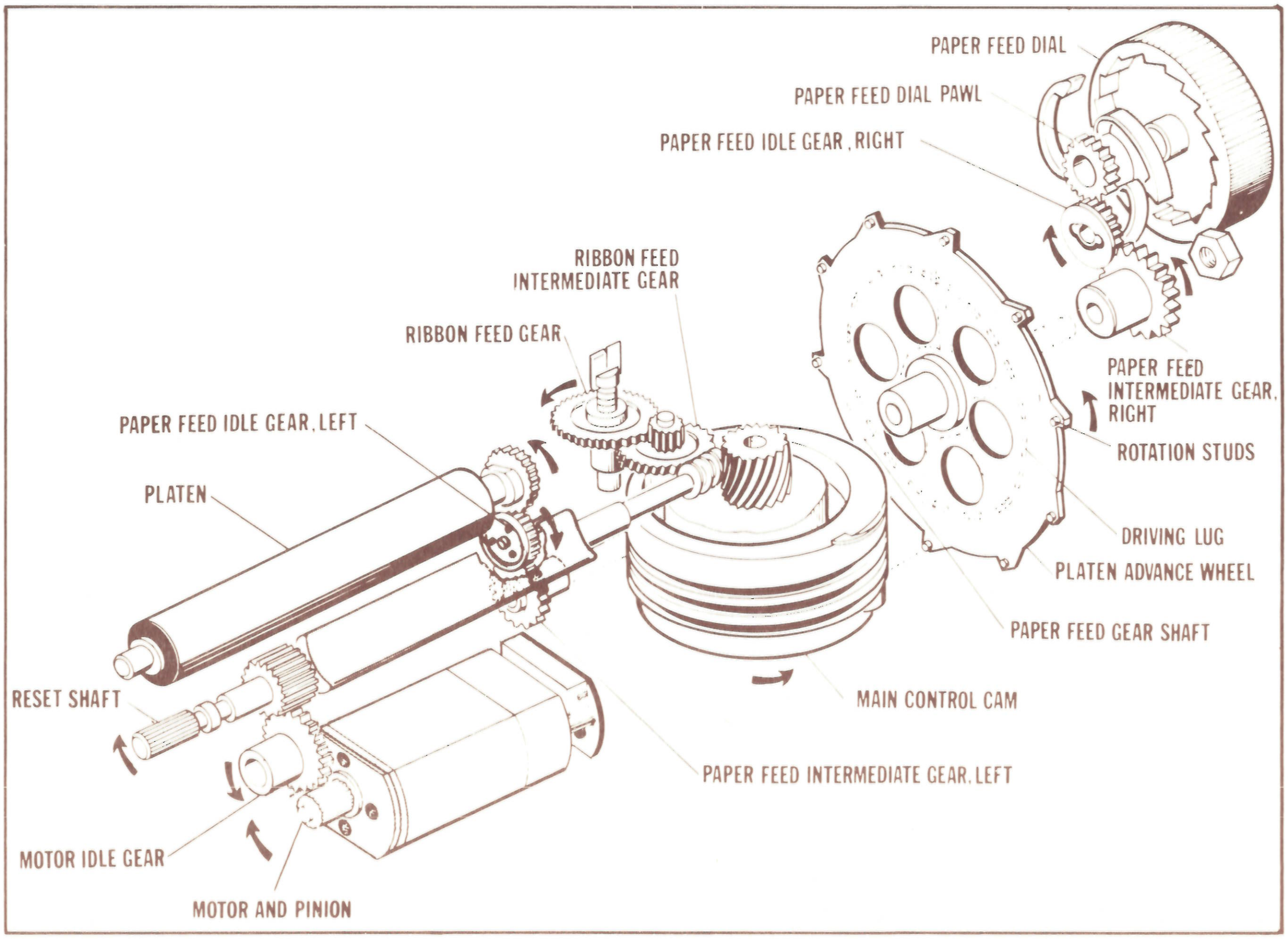


FIG. 12: POWER TRAIN.

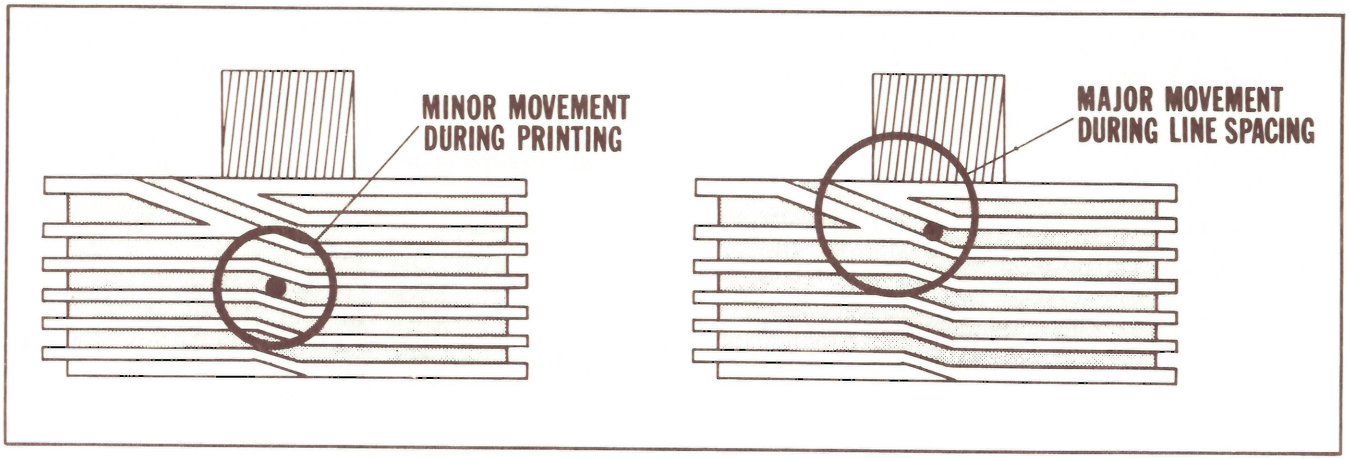

MINOR MOVEMENT DURING PRINTING
MAJOR MOVEMENT DURING LINE SPACING

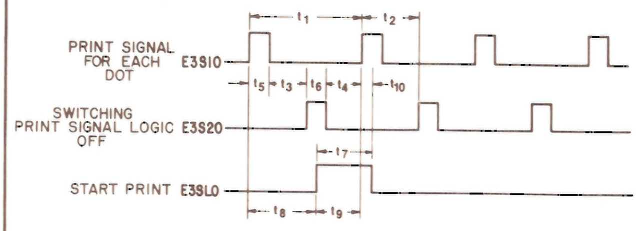
FIG. 13: MAIN CONTROL CAM AND ROTATION STUD.

ELECTRONICS OF PRINTING

THE STROBE DISC OF THE PRINTER SUPPLIES THREE SIGNALS TO THE E.C.U. THESE SIGNALS ARE E3S10, E3S20, AND E3SL0. SEE FIG. 14.

E3S10 IS THE DOT PRINT SIGNAL, AND IS GENERATED CONTINUOUSLY AS THE STROBE DISC REVOLVES.

E3S20 IS ALSO GENERATED CONTINUOUSLY. IT IS THE NO PRINT OR ELECTRONIC "OFF" THAT OCCURS ALTERNATELY WITH E3S10. E3SL0 IS PRODUCED ONLY AT THE END OF A PRINT CYCLE, BY THE ACTIVATION OF THE E3SL0 ACTIVATION BRIDGE BY THE PLATEN ADVANCE WHEEL, AS IT IS DRIVEN BY THE MAIN CONTROL CAM. THE PRINTED TRACK ON THE STROBE DISC WHICH PRODUCES E3SL0 PASSES THE WIPERS FOUR TIMES DURING A PRINT CYCLE, BUT ON THE FOURTH PASS A RAMP ON THE PLATEN ADVANCE WHEEL PRESSES ONE END OF THE ACTIVATION BRIDGE, WHICH POSITIONS THE MOVABLE WIPER FOR CONTACT WITH THE E3SL0 PRINTED SIGNAL TRACK ON THE STROBE DISC. THIS MECHANICAL ACTIVATION OCCURS WHILE THE PRINT NEEDLES ARE MOVING TO THE RIGHT AFTER COMPLETING A LINE OF CHARACTERS, OR AT ABOUT THE SAME TIME THAT THE PLATEN IS ADVANCED UPWARD FOR THE NEXT LINE OF CHARACTERS. SEE FIG. 6.


PRINT SIGNAL FOR EACH DOT E3S10
SWITCHING PRINT SIGNAL LOGIC OFF E3S20
START PRINT E3SL0
t1
t2
t5
t3
t6
t4
t10
t7
t8
t9

$t_1 = 3.84 \div 10.40$ ms

$t_2 = 1.53 \div 5.76$ ms

$t_3 > 120$ µs

$t_4 > 120$ µs

$t_5 > 0.54$ ms

$t_6 > 0.62$ ms

$t_7 > 0.95$ ms

$t_8 = 1.62 \div 6.75$ ms

$t_9 = 1.22 \div 6.15$ ms

$t_{10} > 120$ µs

FIG. 14: STROBE DISC SIGNALS

WHEN PRINTING IS REQUIRED THE E.C.U. STARTS THE PRINTER MOTOR. THE E.C.U. MUST KNOW WHEN THE PRINTER IS IN THE CORRECT POSITION FOR PRINTING: IT WILL KNOW THIS WHEN THE STROBE DISC SENDS SIGNALS E3S10 AND E3SL0. THESE TWO SIGNALS MUST OCCUR TOGETHER OR OVERLAP FOR A PERIOD OF 120 MICROSECONDS. WHEN THIS OCCURS THE E.C.U. WILL ENERGIZE THE BOBBINS AS REQUIRED TO PRODUCE THE DOTS FOR CHARACTERS TO BE PRINTED.

Throughout a print cycle, the E.C.U. counts the E3S10 signals through the 80th dot position. Dots 71 through 80 do not print, but during this interval the platen advances and the E3SLO wiper is positioned for contact. At the 71st dot position the motor voltage stops. Signal E3SLO has not occured although the wiper is in position against the disc. When the E.C.U. starts the motor, E3SLO is recognized along with the first dot signal E3S10. When the E.C.U. recognizes the overlap of these two signals (see Fig. 14; T10>120 us), it approves the print cycle and all dots will be printed as required. If the overlap of the two signals does not occur for any reason, the machine will run through a print cycle with no dots printed until the E.C.U. recognizes the presence of both E3S10 and E3SLO. In much the same way the E.C.U. will cycle the printer without dots after a result is printed; this is how jump totals are accomplished.

THE START OF PRINTING

When the printer is at normal rest position the platen advance wheel has stopped and the tip of the E3SLO activation bridge is positioned on top of one of the ramps. In this condition the activation bridge has been rotated slightly counterclockwise, which has raised the E3SLO plunger. The plunger has pressed the E3SLO wiper into contact with the strobe disc. See Fig. 15.

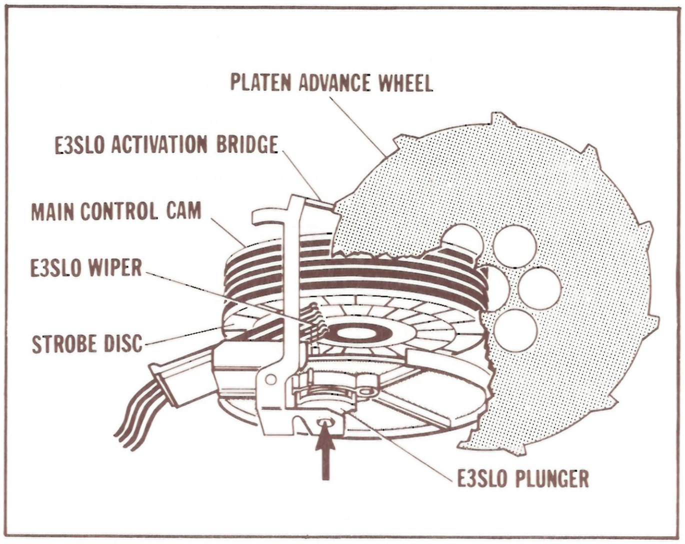


Fig. 15: E3SLO wiper activation.

It is important to understand that the preparation for E3SLO is a mechanical operation, and that it occurs only once in four revolutions of the main control cam. Fig. 16 below shows the different positions of the E3SLO wiper: on the left the wiper is clear of the strobe disc as in most of the print cycle; on the right it is in contact with the disc in preparation for signal E3SLO. This condition, and the signal overlap that will result, will indicate to the E.C.U. that the platen, platen advance wheel, print needles, main control cam and strobe disc are in correct position to start printing as soon as the E.C.U. starts the motor.

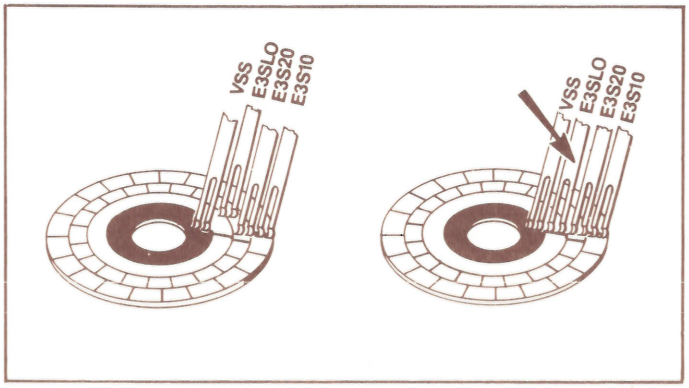


Fig. 16: E3SLO wiper activation

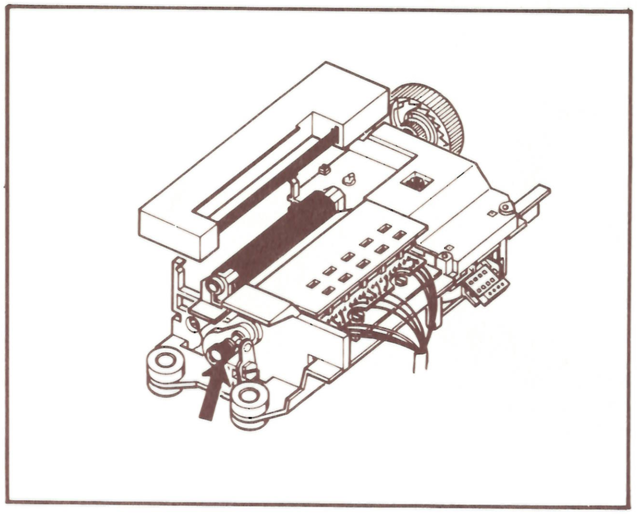


FIG. 17: KNURLED END OF RESET SHAFT

TO FULLY UNDERSTAND THE PRINTER, ROTATE THE PRINTER BY HAND SO THE THEORY AND OPERATIONS CAN BE SEEN. ON THE LEFT OF THE PRINTER IS THE KNURLED END OF THE RESET SHAFT. SEE FIG. 17. THIS HAS BEEN PROVIDED SO THAT THE TECHNICIAN CAN EASILY ROTATE THE RESET SHAFT AND THUS OPERATE THE PRINTER BY HAND. TO DO THIS, TURN THE RESET SHAFT CLOCKWISE AS YOU LOOK AT THE LEFT SIDE. NEVER TURN THE RESET SHAFT COUNTERCLOCKWISE AS THIS WILL DAMAGE THE PRINTER. IT IS PERFECTLY ALL RIGHT TO LEAVE THE PRINTER IN ANY ROTATED POSITION. WHEN IT IS REINSTALLED IT WILL OPERATE NORMALLY.

IN SOME CASES THE PRINTER MAY RUN A LITTLE LONGER. THIS IS BECAUSE THE E.C.U. MUST RECEIVE THE TWO SIGNALS E3S10 AND E3SL0 IN ORDER TO START A NORMAL PRINTING CYCLE. IF THE E3SL0 ACTIVATION BRIDGE HAS NOT BEEN ROTATED BY THE PLATEN ADVANCE WHEEL, THE MOTOR WILL CONTINUE TO RUN UNTIL THE E3SL0 ACTIVATION HAS TAKEN PLACE AND SIGNAL E3SL0 HAS OCCURED AS PREVIOUSLY DESCRIBED.

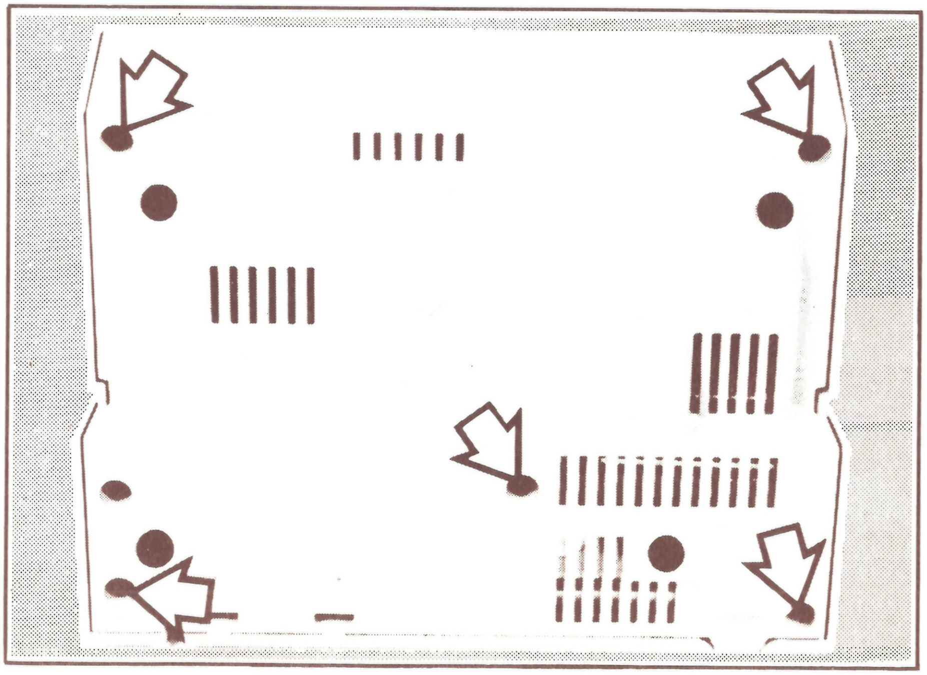
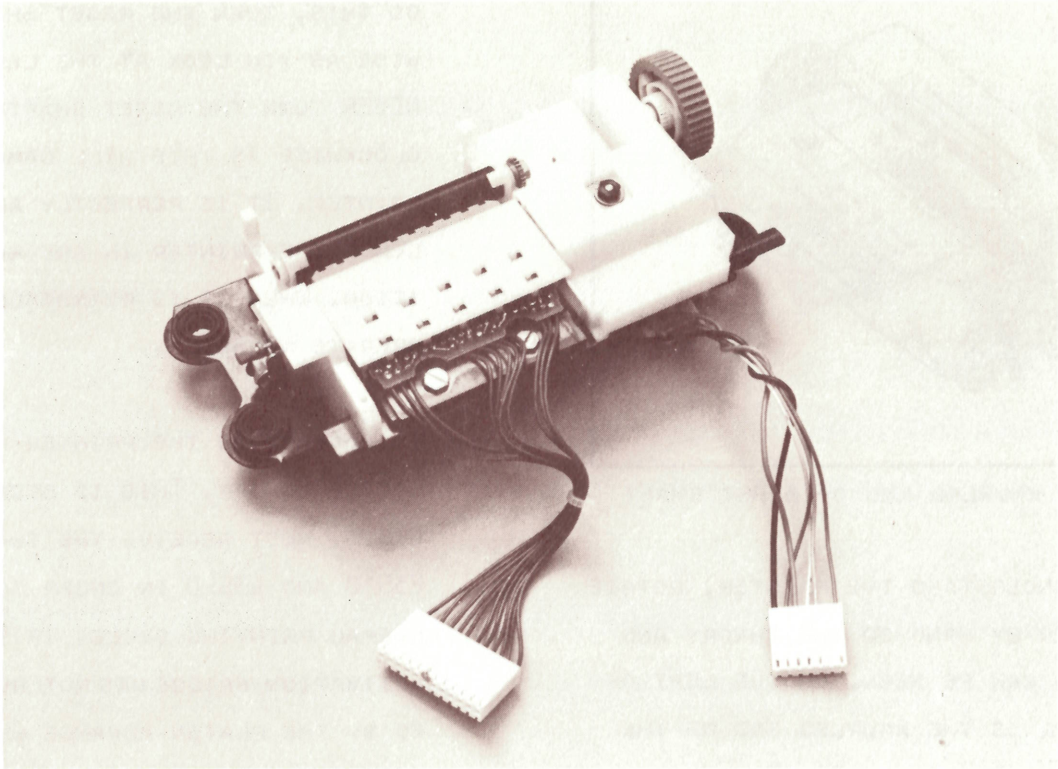


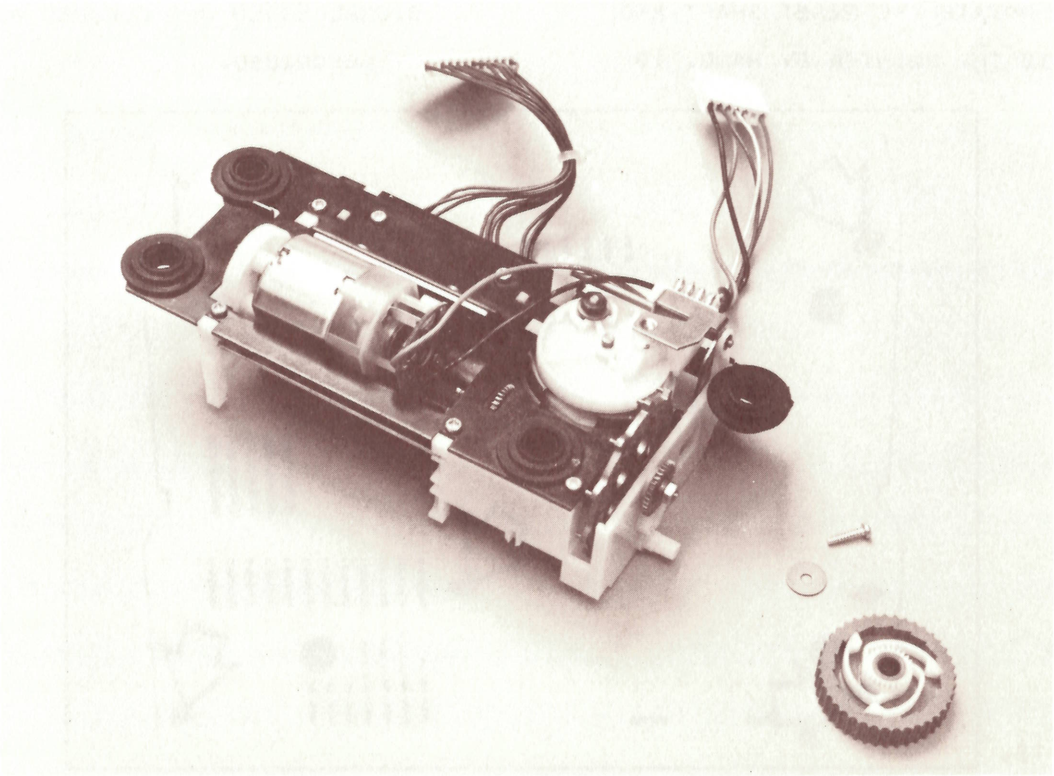
FIG. 18.

THE ONLY FASTENING DEVICE FOR ALL OF THE MODULES AND COVERS IS A SERIES OF FIVE MACHINE SCREWS WITH CAPTIVE WASHERS, WHICH MAINTAINS THE TOP AND BOTTOM COVERS IN POSITION AND AT THE SAME TIME, BY MEANS OF CASE DESIGN, MAINTAINS ALL MODULES IN THEIR RESPECTIVE POSITIONS. TO COMPLETELY DISASSEMBLE THE COVERS AND SEPARATE THE MODULES, SIMPLY REMOVE THE FIVE SCREWS AS INDICATED.

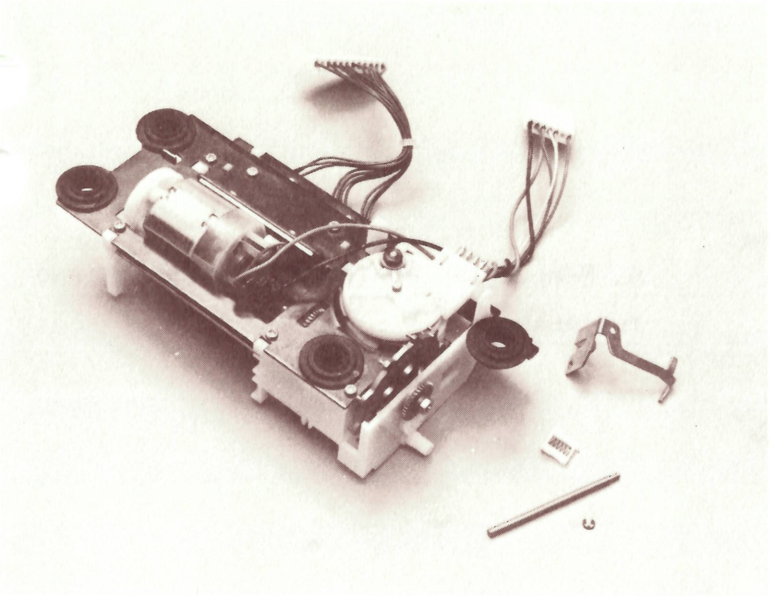
PRINTER DISASSEMBLY



1. REMOVE RIBBON CARTRIDGE.

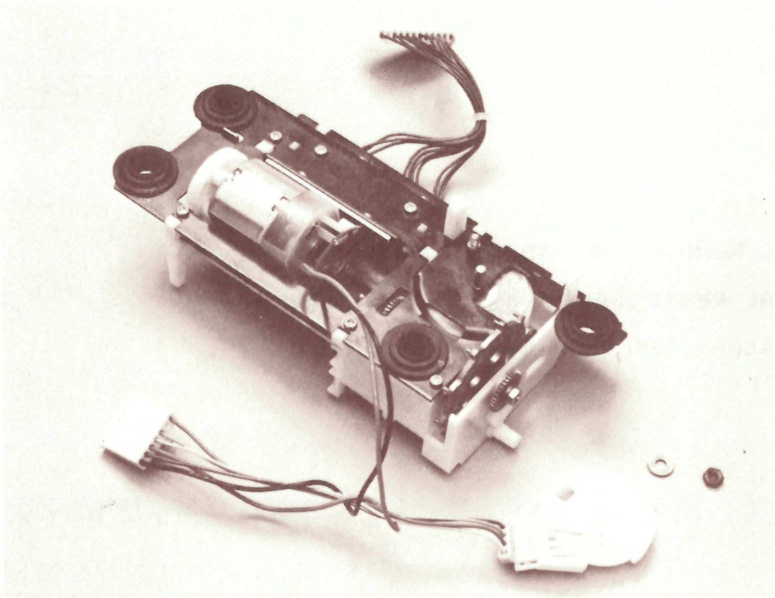


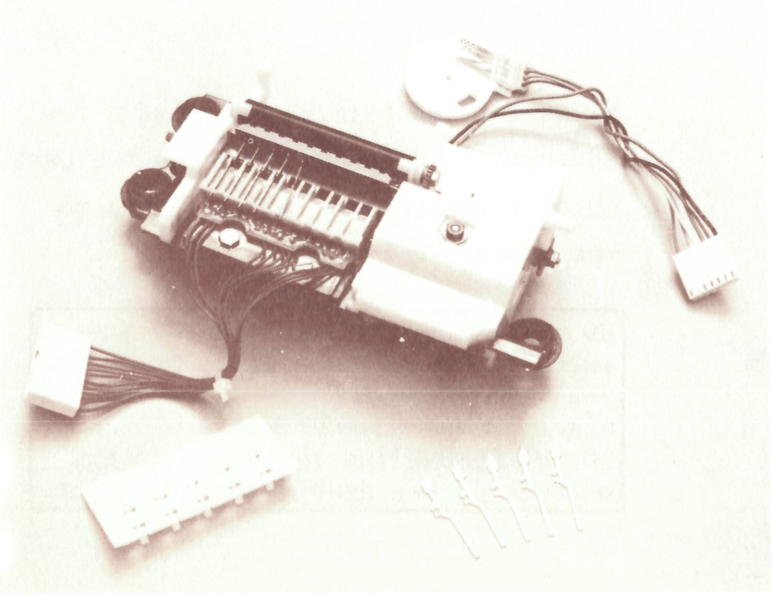
2. REMOVE THE SCREW HOLDING THE PAPER FEED DIAL AND PAWL; REMOVE THE DIAL AND PAWL; INVERT THE PRINTER.



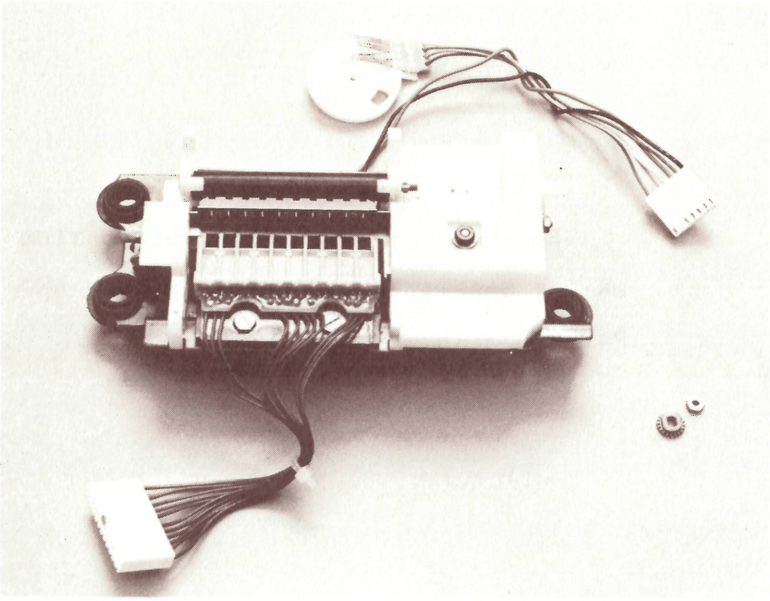
3. REMOVE C-CLIP FROM E3SLO ACTIVATION BRIDGE SHAFT; REMOVE SHAFT, BRIDGE AND PLUNGER WITH SPRING.

4. REMOVE NUT AND WASHER HOLDING THE STROBE GROUP, AND REMOVE THE STROBE GROUP. RE-INVERT THE PRINTER.



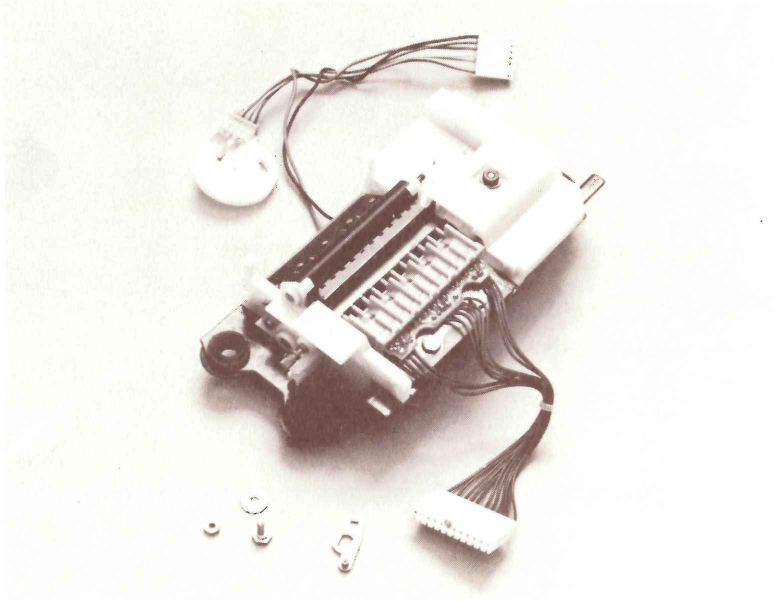


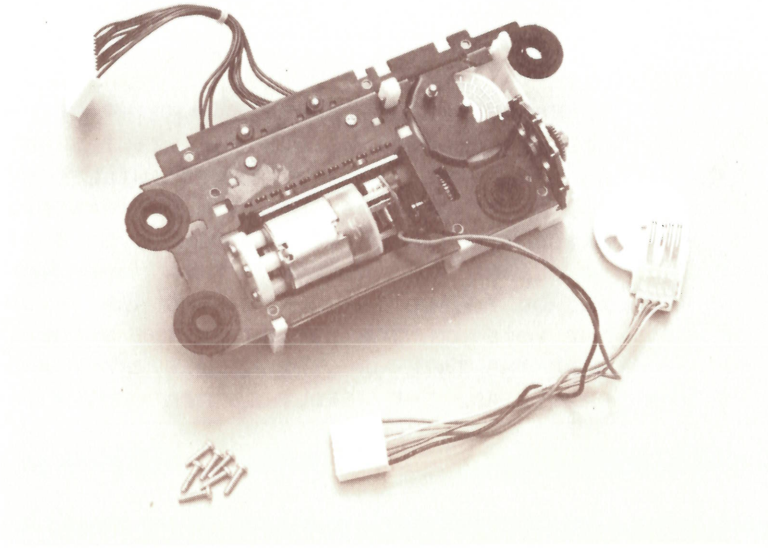
5. REMOVE NEEDLE COVER, AND PRINT NEEDLES AS FOLLOWS: ROTATE THE RESET SHAFT SO THAT ONE OF ITS "FLATS" WILL FACE THE RESET SPRINGS (MAXIMUM CLEARANCE). RAISE THE "TAIL" OF THE NEEDLE SO THAT IT CLEARS THE ANCHOR, THEN MOVE THE ANCHOR TOWARD THE PLATEN AND AWAY FROM THE YOKE ON THE BOTTOM OF THE NEEDLE. MOVE THE TAIL OF THE NEEDLE DOWN AND FRONT, AND THE NEEDLE IS REMOVED.



6. REMOVE THE PLATEN DRIVE GEAR NUT AND THE GEAR.

7. REMOVE THE ADJUSTING MECHANISM OF THE RESET SHAFT: REMOVE THE LOCKNUT AND WASHER, ECCENTRIC, AND LEVER.



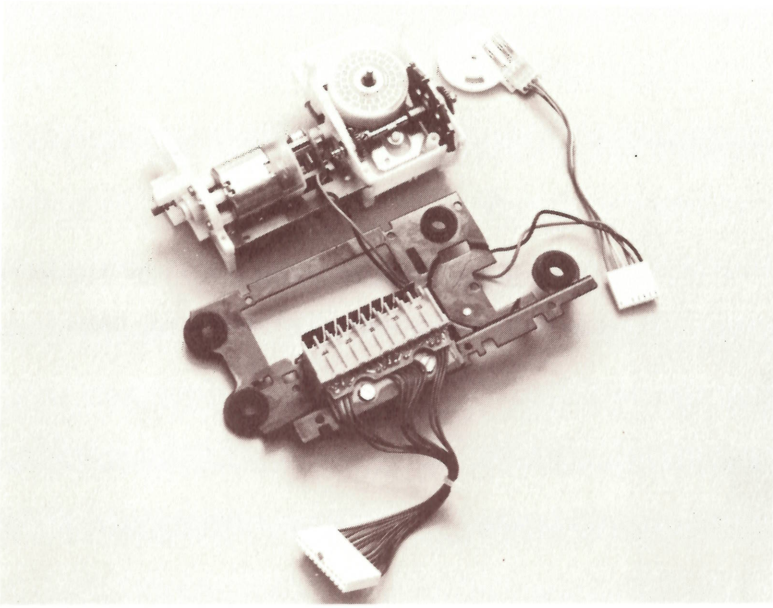


8. INVERT THE PRINTER AND REMOVE THE SEVEN TAPPING SCREWS SECURING THE LEFT OUTER SIDEWALL AND RIGHT HOUSING TO THE SUPPORT PLATE.

IMPORTANT

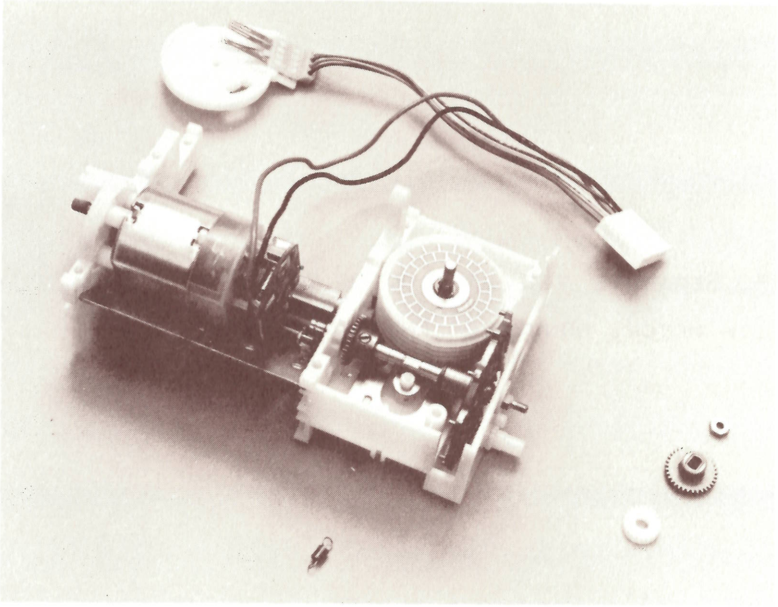
DO NOT REMOVE THE TWO TAPPING SCREWS WHICH HOLD THE ANCHOR GUIDE IN PLACE; THE PRINTING MECHANISM CAN BE LEFT IN PLACE ON THE SUPPORT PLATE.

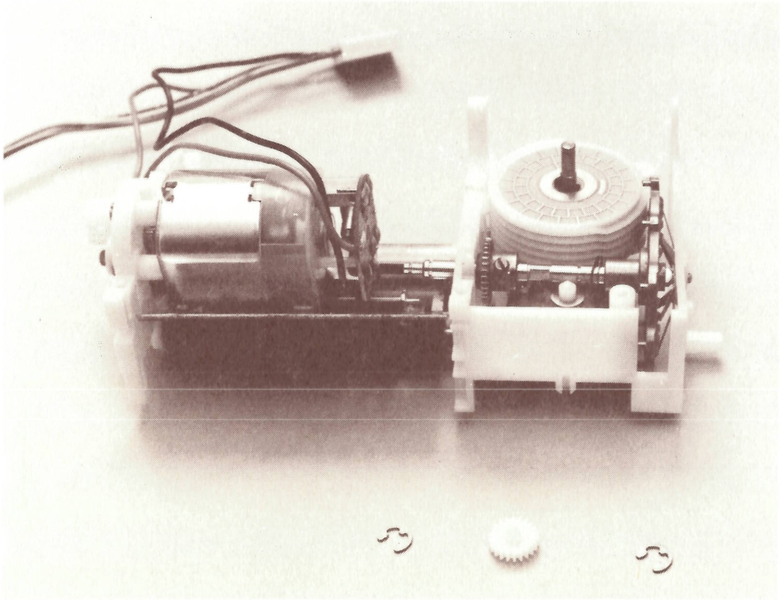
DO NOT REMOVE THE TWO SHORT SCREWS WHICH HOLD THE RESET SPRING IN PLACE.



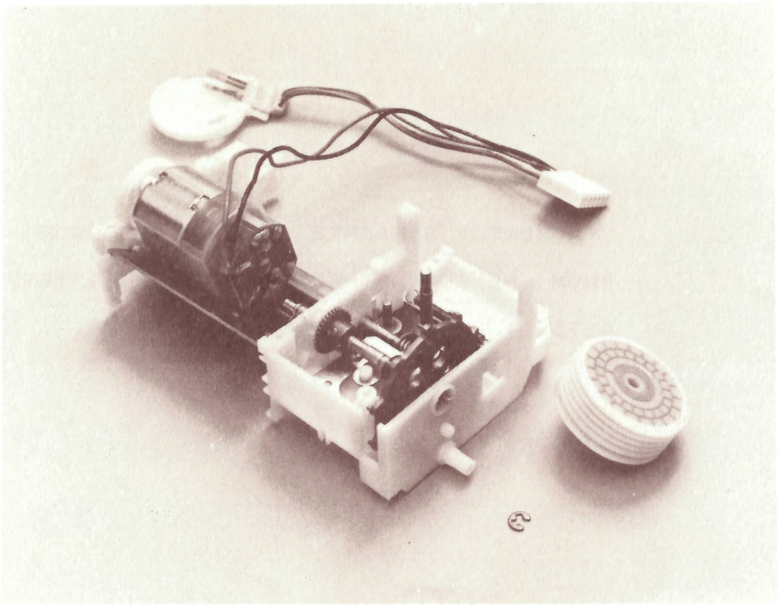
9. GENTLY SEPARATE THE DRIVE GROUP FROM THE SUPPORT-AND-PRINT GROUP. SET ASIDE THE SUPPORT-AND-PRINT GROUP.

10. REMOVE THE LOCKNUT WHICH HOLDS THE PAPER FEED INTERMEDIATE GEAR (RIGHT) AND REMOVE THE GEAR; ALSO REMOVE THE PAPER FEED IDLE GEAR (RIGHT). REMOVE SPRING FROM THE OTHER END OF PAPER FEED GEAR SHAFT.



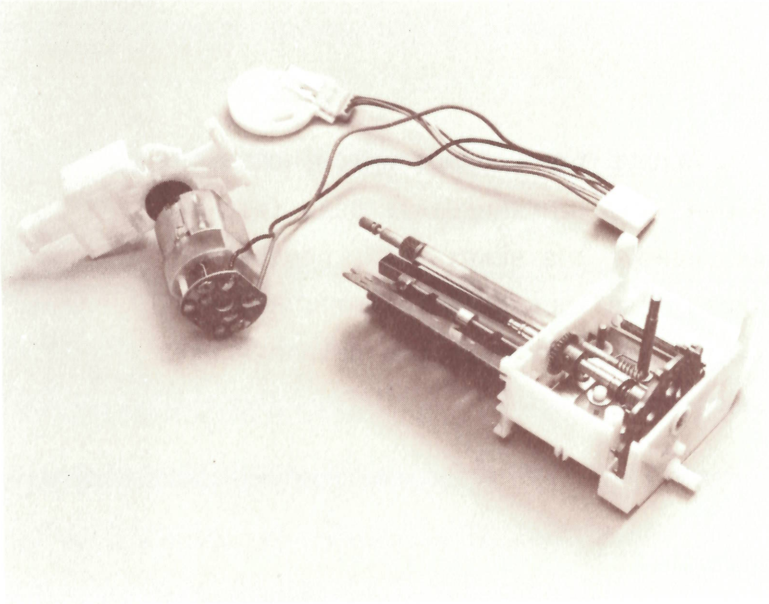


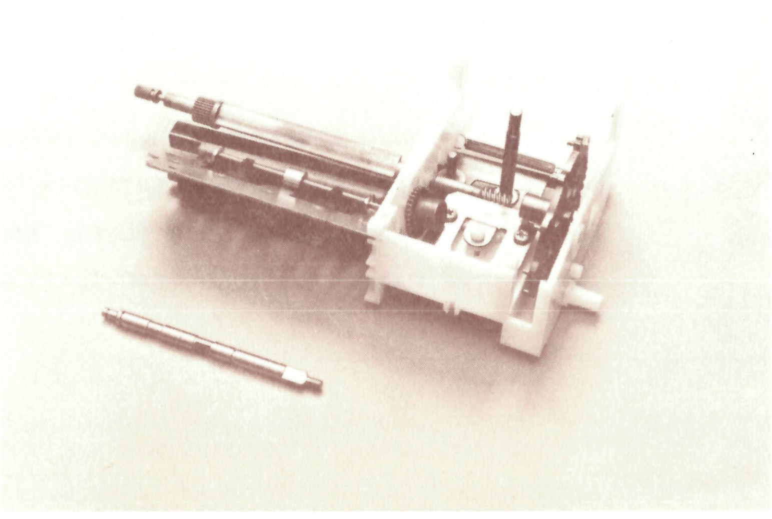
11. REMOVE BOTH C-CLIPS FROM THE PAPER FEED GEAR SHAFT. LOOSEN THE SETSCREW OF PAPER FEED INTERMEDIATE GEAR (LEFT) AND REMOVE THE PAPER FEED IDLE GEAR (LEFT).



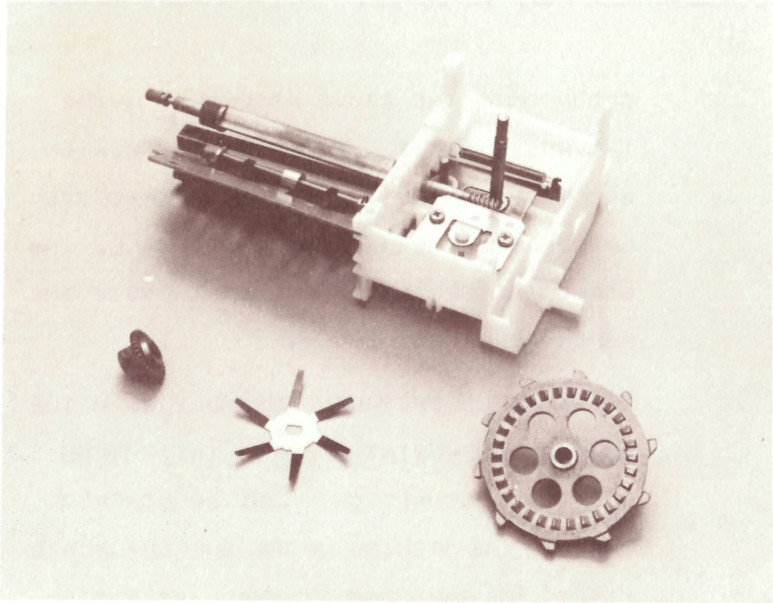
12. REMOVE C-CLIP FROM SHAFT OF THE MAIN CONTROL CAM, AND LIFT OUT THE CAM.

13. SEPARATE THE LEFT OUTER SIDEWALL WITH MOTOR, CONNECTOR AND STROBE GROUP.



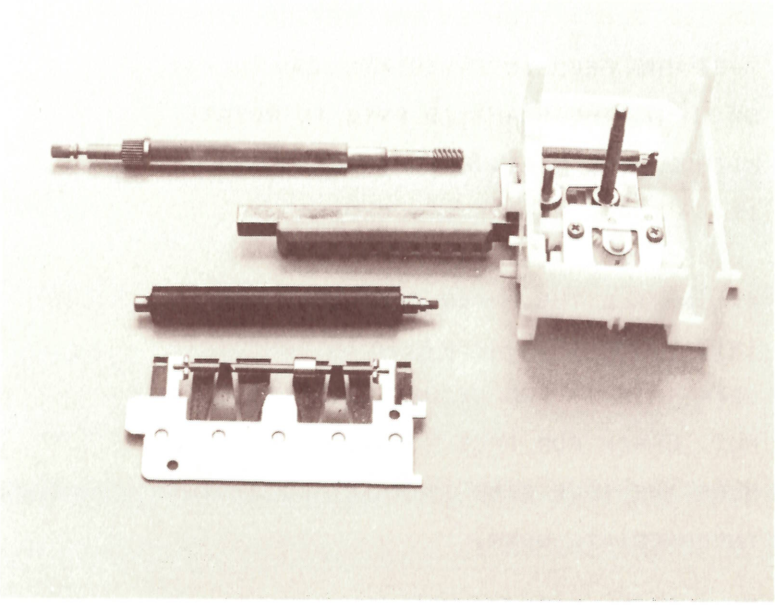


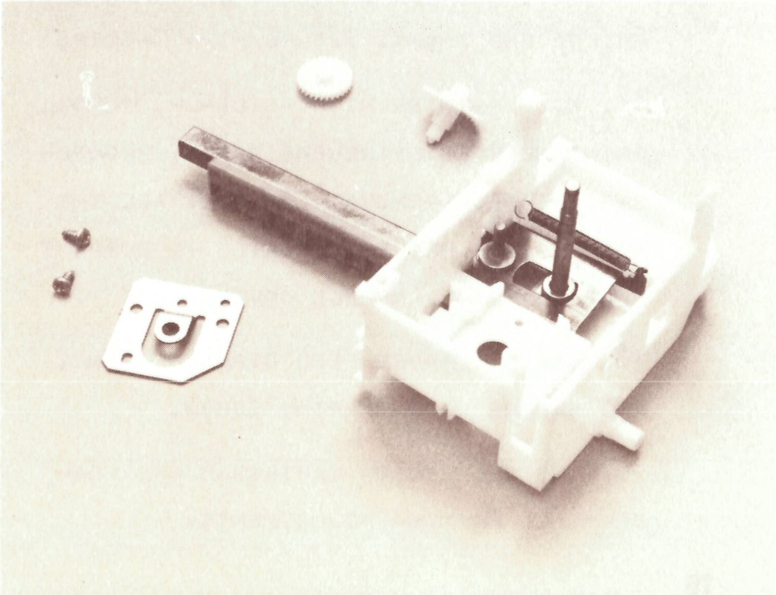
14. REMOVE THE PAPER FEED GEAR SHAFT.



15. Remove the platen advance wheel and spider spring, and the paper feed intermediate gear (left).

16. Remove platen, paper guide group, and reset shaft (it is still engaged with the ribbon drive train, but it will pull out; do so carefully).





17. Remove the two screws holding the ribbon feed gear plate, and lift out the plate and the two gears.

REASSEMBLY OF PRINTER

BEGIN WITH THE RIGHT HOUSING, INVERTED.

1. INSERT RIBBON FEED GEAR, INTERMEDIATE GEAR, AND THE PLATE. INSTALL TWO SCREWS.

2. PLACE THE SPIDER SPRING, PLATEN ADVANCE WHEEL AND PAPER FEED INTERMEDIATE GEAR (LEFT) IN THE HOUSING, IN THEIR APPROXIMATE POSITIONS; INSERT THE PAPER FEED GEAR SHAFT, THREADED END FIRST. BE CAREFUL WITH THE SPIDER SPRING: IT IS KEYED TO THE SHAFT BY "FLATS". INSTALL BOTH C-CLIPS.

3. PLACE THE PAPER FEED IDLE GEAR (LEFT) IN ITS SLOT; TIGHTEN THE SETSCREW OF THE PAPER FEED INTERMEDIATE GEAR (LEFT) SO THAT THE SHAFT IS FREE TO ROTATE WITHOUT END PLAY. BE SURE THE IDLE GEAR IS IN PLACE BEFORE PROCEEDING.

4. INSTALL THE PAPER FEED IDLE GEAR (RIGHT) AND THE PAPER FEED INTERMEDIATE GEAR (RIGHT) AND SECURE WITH ITS LOCKNUT. CHECK FOR FREE ROTATION, AND BE SURE THE IDLE GEAR IS RETAINED BY THE INTERMEDIATE GEAR.

5. INSTALL MAIN CONTROL CAM AND C-CLIP.

6. INSTALL THE PLATEN AND PLATEN DRIVE GEAR (CHECK FOR PROPER MESH WITH IDLE GEAR), AND SECURE WITH LOCKNUT.

7. INSERT THE RESET SHAFT: IT MUST ENGAGE THE RIBBON FEED GEAR TRAIN AND THE MAIN CONTROL CAM, SO ROTATE THE SHAFT WHILE INSERTING.

8. INSTALL THE PAPER GUIDE GROUP SO THAT THE SPRINGS CURL AROUND THE PLATEN.

9. INSTALL THE LEFT SIDEWALL-AND-MOTOR GROUP ONTO THE ABOVE ASSEMBLY. GUIDE THE RESET SHAFT, NEEDLE GUIDE, PLATEN AND PAPER GUIDE INTO THEIR RESPECTIVE OPENINGS IN THE LEFT OUTER SIDEWALL. INSTALL THE SPRING ON THE LEFT END OF THE PAPER FEED GEAR SHAFT.

10. COMBINE THE ABOVE ASSEMBLY WITH THE SUPPORT-AND-PRINT GROUP; THE STROBE GROUP AND CONNECTOR MUST BE LOWERED THROUGH THE OPENING IN THE SUPPORT PLATE FIRST. BE SURE THE SIDEWALL EXTENSION TABS ARE LOCATED CORRECTLY, AND SECURE WITH THE SEVEN TAPPING SCREWS, PUTTING THE STAR WASHER IN ITS ORIGINAL PLACE.

11. INSTALL THE RESET SHAFT ADJUSTING MECHANISM; FIRST THE LEVER, THEN THE ECCENTRIC SCREW, THEN THE WASHER AND NUT. MAKE THE ASSEMBLY SNUG IN MIDRANGE FOR LATER ADJUSTMENT.

12. INSTALL THE STROBE GROUP AND SECURE WITH WASHER AND NUT; SNUG NUT IN MIDRANGE AND ADJUST LATER.

13. INSTALL THE E3SLO PLUNGER WITH ITS SPRING (PLUNGER IS KEYED TO PREVENT IMPROPER INSERTION), E3SLO ACTIVATION BRIDGE AND SHAFT. SECURE WITH C-CLIP.

14. WITH PRINTER RIGHT-SIDE-UP, INSTALL PRINT NEEDLES BY REVERSING THE PROCEDURE USED FOR REMOVAL. BE SURE ALL THE ANCHORS ARE PROPERLY SEATED IN SUPPORT PLATE. INSTALL NEEDLE COVER.

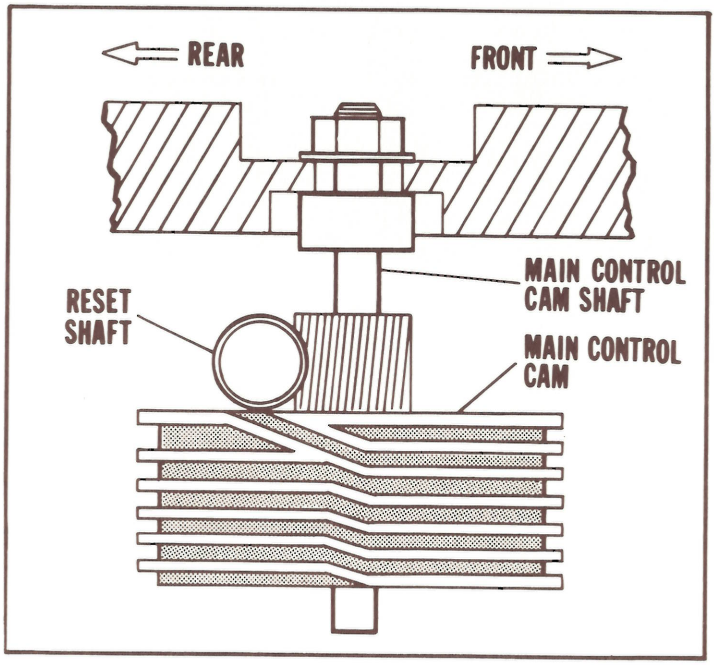
15. INSTALL PAPER FEED DIAL AND PAWL, AND SECURE WITH TAPPING SCREW.

16. INSTALL RIBBON CARTRIDGE AND PERFORM ALL PRINTER ADJUSTMENTS.

MAIN CONTROL CAM TO RESET SHAFT ADJUSTMENT

THIS ADJUSTMENT IS REQUIRED AFTER REPLACEMENT OF EITHER THE MAIN CONTROL CAM OR THE RESET SHAFT.

THE MESH BETWEEN THE MAIN CONTROL CAM AND THE RESET SHAFT MUST BE AS DEEP AS POSSIBLE WITHOUT BINDING. TO OBTAIN THIS CONDITION, LOOSEN THE NUT ON THE MAIN CONTROL CAM SHAFT AND MOVE SHAFT TO THE FRONT OR REAR AS NECESSARY, THEN TIGHTEN THE NUT ON THE SHAFT.



VERIFY THE ADJUSTMENT BY ROTATING THE PRINTER BY HAND THROUGH A COMPLETE REVOLUTION OF THE MAIN CONTROL CAM (SEVEN REVOLUTIONS OF THE RESET SHAFT) TO REVEAL ANY BINDING BETWEEN THE MAIN CONTROL CAM AND THE RESET SHAFT.

MOTOR ADJUSTMENT

THIS ADJUSTMENT IS REQUIRED AFTER REPLACING THE MOTOR; IT IS NOT REQUIRED WHEN FOLLOWING THE PRECEEDING DISASSEMBLY PROCEDURE.

AFTER INSTALLING THE MOTOR TO THE LEFT OUTER SIDE PLATE, ADJUST THE MOTOR SO THAT THE TEETH ON THE MOTOR PINION AND THE MOTOR IDLE GEAR MESH AS DEEPLY AS POSSIBLE WITHOUT BINDING, THEN TIGHTEN THE THREE MOTOR SCREWS. THE MESH CAN BE OBSERVED THROUGH THE INSPECTION HOLE IN THE LEFT OUTER SIDE PLATE.

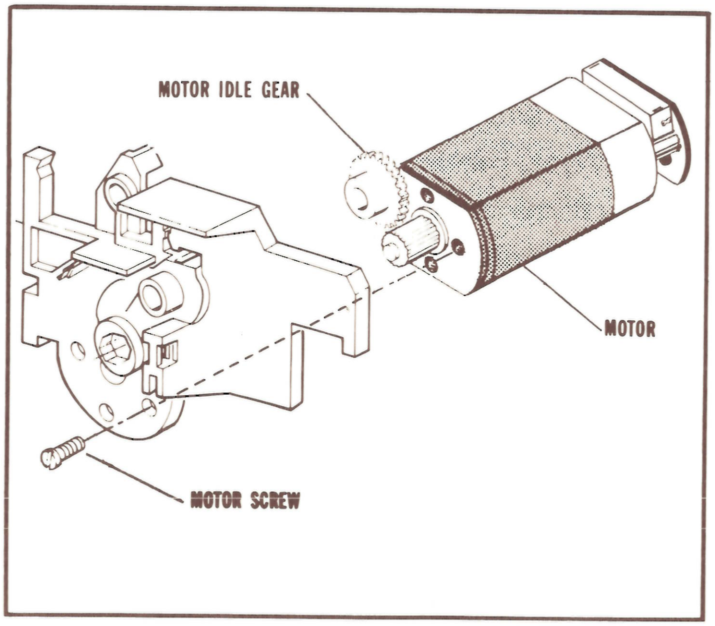


FIG. 19: MOTOR ADJUSTMENT

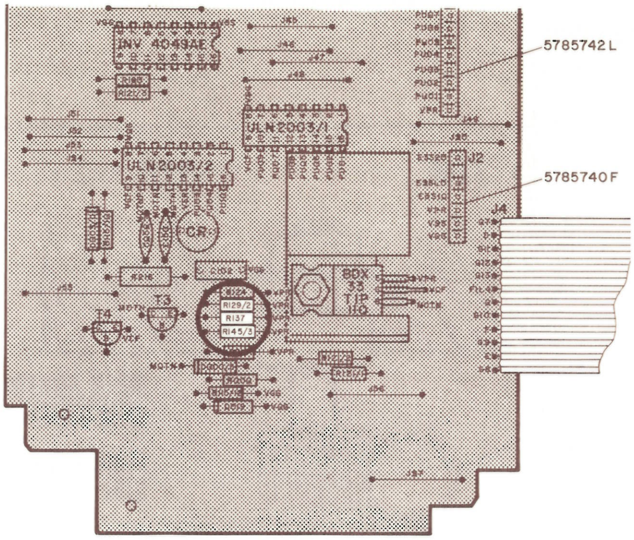


Fig. 20: Motor speed adjustment

MOTOR SPEED ADJUSTMENT

The speed of the printer is determined by the voltage reaching the motor. This voltage can be adjusted by means of the resistors R129/2, R137 and R145/3 on the E.C.U. Values of these resistors are 22 Kohm, 47 Kohm, and 100 Kohm respectively. By cutting one or more of these resistors out of the circuit, the voltage to the motor is increased; see the wiring schematic. Printer speed may need adjustment because of variances that occur in manufacturing. All factory assembled printers are coded with a letter located on the motor indicating which resistors should be cut to provide correct motor speed. Below is a legend showing the significance of the letter placed on the printer at the factory.

Code	Adjustment	Relative speed
A	No cut: all intact	Slower
B	R145/3 is cut	↑
C	R145/3, R137 cut	
D	R129/2 is cut	Normal
E	R129/2, R145/3 cut	
F	R129/2, R137 cut	↓
G	All three cut	Faster

If the original motor on the printer was stamped "A" no resistors will be cut on the E.C.U. If it was stamped "B" resistor R145 will be cut, and so on. The serviceman replacing the printer must note the letter stamped on the motor, and also any cut resistors on the E.C.U. Following the legend, match the E.C.U. to the motor by cutting or re-soldering the resistors as needed.

The serviceman replacing the motor in the original printer has no such guide except the relative speeds indicated in the legend. Reassemble the printer and check print speed.

On a clear tape enter some numerals and depress the non-add key so as to operate the printer continuously. This is easiest accomplished by depressing the key rapidly several times, then at the same rate as the printer operates. Count the number of print cycles in a period of at least ten seconds, then divide the number of print cycles by the number of seconds to obtain the print speed in lines per second. Print speed should be close to 1.7 lines per second. As long as print quality is good, any speed between 1.5 and 1.9 lines per second is acceptable.

If a reassembled printer is notably slower than the range indicated above, the serviceman should check all lubrication points involved in the reassembly, and especially the mesh of the motor pinion and the idle gear, and the reset shaft adjustment.

ADJUSTMENTS TO E3SLO ACTIVATION BRIDGE

This adjustment is required after replacement of the strobe disc, strobe contact assembly, main control cam, E3SLO activation bridge or plunger, or any other repair that may disturb the adjustment of these components.

First rotate the printer by hand using the knurled end of the reset shaft until a rotation stud on the platen advance wheel is in the first groove of the main control cam as shown in Fig. 21. View is from the right end of the printer. In this condition wing "A" of the E3SLO activation bridge should be even with, or slightly overlapping the platen advance wheel ramp by a maximum clearance of 0.2 mm. To obtain this condition form wing "A". Once this adjustment is obtained do not rotate the printer until the next adjustment.

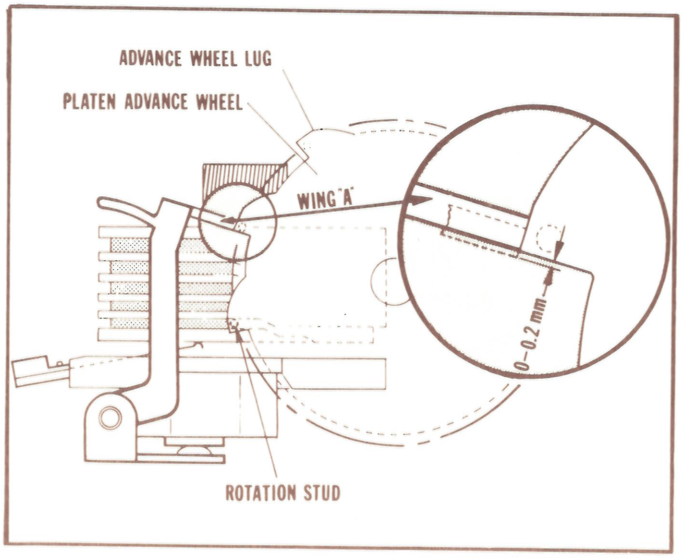


Fig. 21: Adjustment of wing "A"

The next adjustment ensures that the bridge will activate signal E3SLO at the correct time and prevent the same signal from occuring during printing.

On connector J2 (the strobe assembly) insert one meter probe on signal wire VSS and the other probe on signal E3SLO. Place meter range switch on Rx1 scale. Now rotate the reset shaft counterclockwise (backwards) about one half turn. At this point the meter should indicate continuity. If so, the E3SLO wiper has contacted the printed circuit track; if not, the wiper was not moved sufficiently by the bridge. Form wing "B" slightly upward. This will raise the E3SLO plunger and cause the wiper to contact the strobe disc correctly. Now turn the reset shaft clockwise (normal) until linespacing occurs (to the next ramp of the platen advance wheel). During this time the E3SLO wiper must not contact the strobe disc (the meter should not show continuity). If it does, form wing "B" slightly down.

NOTE

This adjustment is the only occasion when the printer is turned backwards

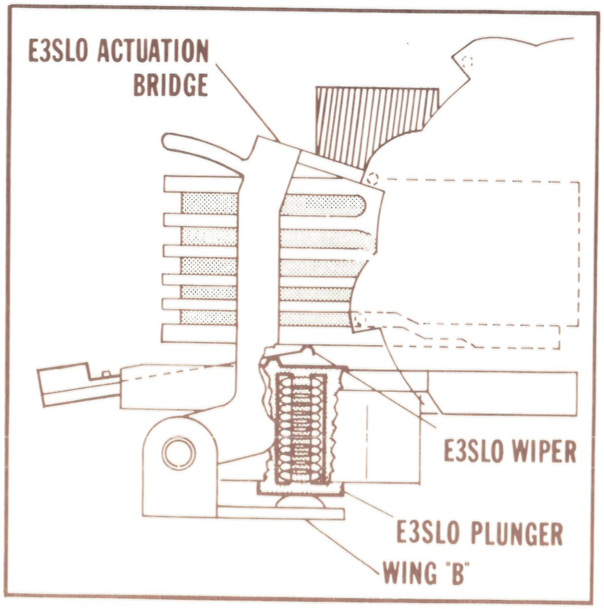


Fig. 22: Adjustment of wing "B"

BOBBIN SUPPORT ADJUSTMENT

THIS ADJUSTMENT WILL BE REQUIRED AFTER REPLACEMENT OF THE MAGNETIC RUBBER, BOBBIN ASSEMBLY, OR BOBBIN SUPPORT.

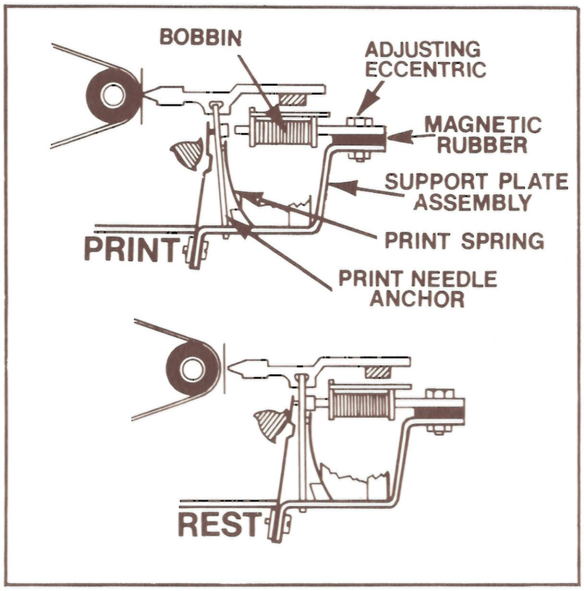


FIG. 23: BOBBIN SUPPORT ADJUSTMENT

THE DISTANCE FROM THE PRINT NEEDLE ANCHOR TO THE BOBBIN SUPPORT MUST BE ADJUSTED TO ENSURE THAT THE RESET SHAFT WILL RESTORE THE ANCHOR FAR ENOUGH TO THE FRONT THAT IT WILL CONTACT AND BE MAGNETICALLY HELD BY THE BOBBIN AND BOBBIN SUPPORT. TO OBTAIN THIS CONDITION ROTATE THE ADJUSTING ECCENTRICS SO THAT THE RESET SHAFT RESTORES THE PRINT NEEDLES TO THE BOBBIN SUPPORT BUT DOES NOT EXERT EXCESSIVE PRESSURE ON THE RESET SPRING DURING RESET, AS IT MAY SLOW THE MOTOR OR DAMAGE THE RESET SPRING. ALSO KEEP IN MIND THAT THIS ADJUSTMENT CAN ALSO AFFECT PRINT DENSITY.

NOTE

WHEN REPLACING THE MAGNETIC RUBBER BETWEEN THE SUPPORT AND THE BOBBIN SUPPORT, BE SURE TO INSERT THE RUBBER IN THE CORRECT POSITION. THE CUTOUT MUST BE TO THE RIGHT AND FACING THE FRONT OF THE PRINTER. INCORRECT INSERTION WILL REVERSE THE POLARITY OF THE MAGNETIC FIELD, AND WHEN THE BOBBINS ARE ENERGIZED THEY WILL REINFORCE THE FIELD INSTEAD OF INTERRUPTING IT: NO PRINT WILL OCCUR.

VERTICAL ALIGNMENT ADJUSTMENT

ENTER A SERIES OF EIGHTS AND ONES. DEPRESS THE NON-ADD KEY TO RUN PRINTER. LOOSEN THE NUT AND ROTATE THE STROBE CONTACT ASSEMBLY TO LEFT AND RIGHT. CENTER THE ASSEMBLY IN THE RANGE WHERE THE DOT ALIGNMENT IS GOOD ON BOTH SIDES OF ALL CHARACTERS. TIGHTEN THE ADJUSTING NUT ON THE STROBE CONTACT ASSEMBLY.

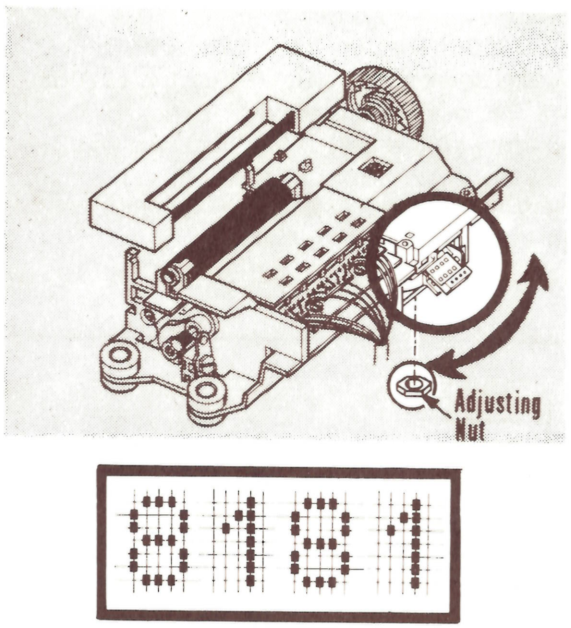


FIG. 24 : VERTICAL ALIGNMENT ADJUSTMENT

PRINT DENSITY ADJUSTMENT

ENTER A SERIES OF EIGHTS AND ONES, AND DEPRESS THE NON-ADD KEY TO CAUSE PRINTING. LOOSEN THE LOCKNUT AND ROTATE THE ADJUSTING ECCENTRIC FOR THE RESET SHAFT TO OBTAIN THE DARKEST POSSIBLE PRINTING. CHECK VERTICAL ALIGNMENT ADJUSTMENT. TIGHTEN LOCKNUT AT OPTIMUM SETTING.

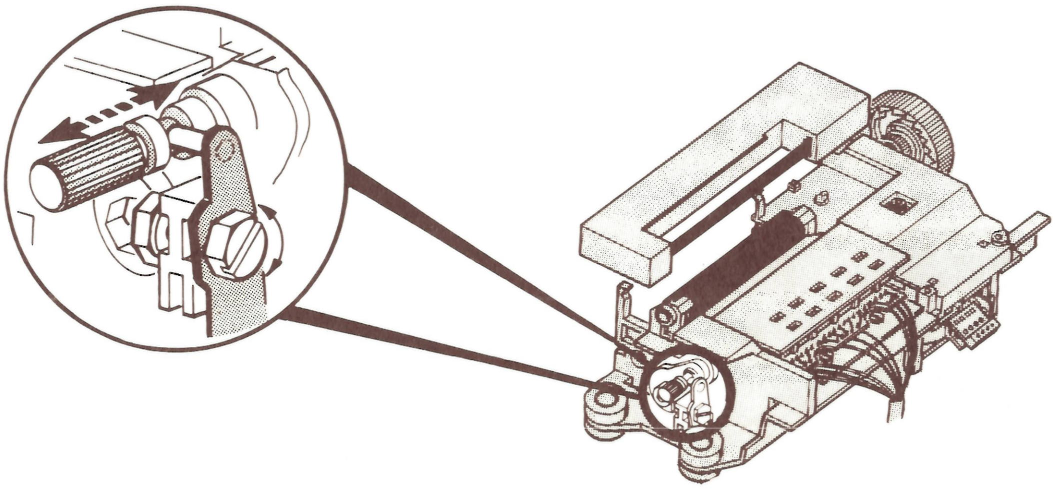


FIG. 25 : PRINT DENSITY ADJUSTMENT

OPERATION OF THE L43/45PD DISPLAY

THE L43/45PD DISPLAY IS A VACUUM TUBE, SIMILAR TO A TRIODE, WITH THE INDIVIDUAL SEGMENTS OF THE CHARACTERS BEING THE PLATE (SEE FIGURE 26). THE PLATES HAVE A PHOSPHOR COATING SIMILAR TO A TV TUBE, SO THAT THEY WILL LIGHT WHEN BOMBARDED BY ELECTRONS FROM THE FILAMENT.

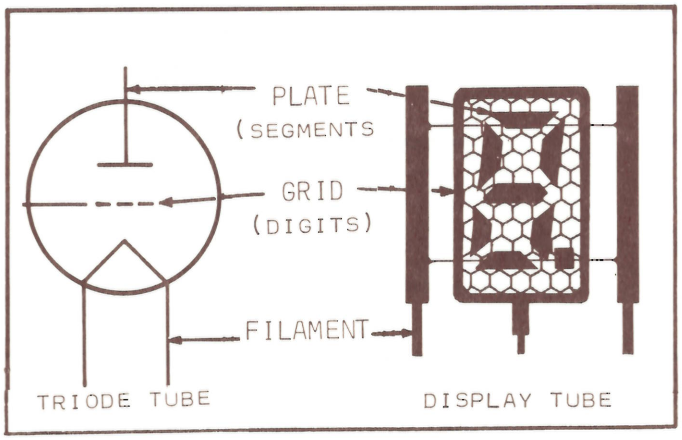


FIG 26: COMPARISON OF TUBES

IN THE TRIODE TUBE THE NEGATIVE VOLTAGE OF THE GRID WOULD BE USED TO CONTROL THE FLOW OF ELECTRONS FROM THE FILAMENT, WHICH IS NEGATIVE, TO THE PLATE , WHICH IS POSITIVE. THIS WOULD CAUSE THE PLATE TO LIGHT. IN THE DISPLAY TUBE, THE GRID WILL EITHER ALLOW OR PREVENT THE FLOW OF ELECTRONS TO THE INDIVIDUAL PLATES (SEGMENTS). THE PHOSPHOR COATING MAKES THE DISPLAY HIGHLY VISIBLE.

EACH DIGIT OF THE DISPLAY TUBE HAS NINE PARTS: EIGHT OF THESE ARE THE SEGMENTS (A THROUGH G PLUS THE DECIMAL), AND THE NINTH IS THE GRID SCREEN LOCATED IN FRONT OF THEM. SEE FIGURE 27.

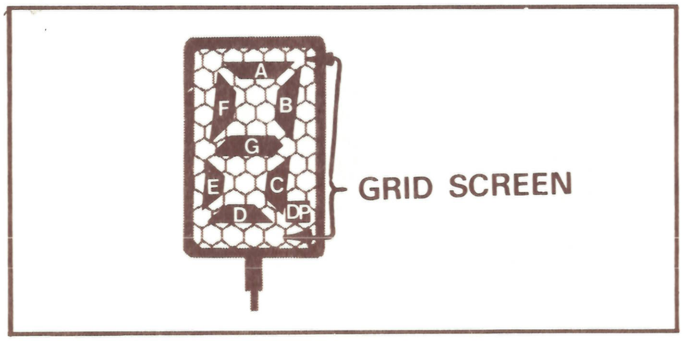


FIG 27: SEGMENTS AND GRID SCREEN

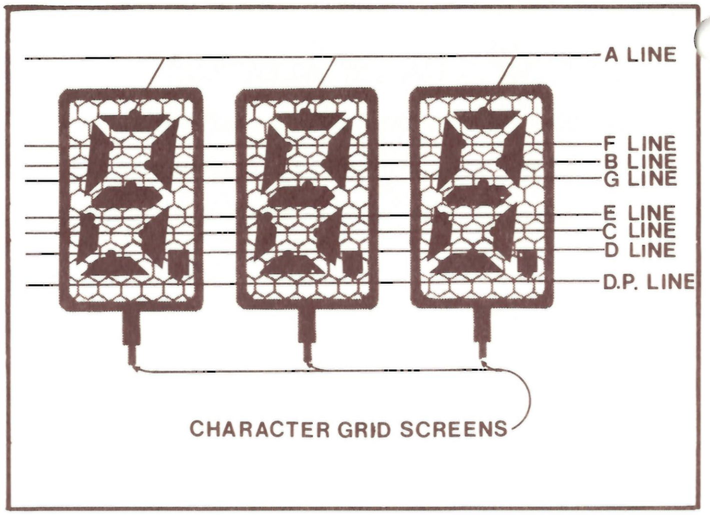


FIG 28: CONDUCTIVE TRACKS

THE SEGMENTS AND THE GRID SCREEN ARE CONNECTED TO THE EXTERNAL LEADS OF THE DISPLAY TUBE BY CONDUCTIVE TRACKS. ALL THIRTEEN SIMILAR SEGMENTS ARE CONNECTED: ALL A SEGMENTS ARE CONNECTED, ALL B SEGMENTS, ETC., AS SHOWN IN FIGURE 28. THE GRID SCREENS FOR INDIVIDUAL CHARACTERS ARE NOT CONNECTED; THEY ARE CONTROLLED INDIVIDUALLY, AS WILL BE EXPLAINED NEXT.

THE DISPLAY IS SCANNED FROM RIGHT TO LEFT APPROXIMATELY 180 TIMES PER SECOND AS ILLUSTRATED BELOW. "SCAN" MEANS THE SEQUENTIAL SWITCHING OF DIGITS (CHARACTER POSITIONS) FROM VDISP (-20.0 VDC) TO VSS (+10 VDC) AND BACK. ALL THIRTEEN POSITIONS ARE SCANNED EACH 1/180 OF A SECOND.

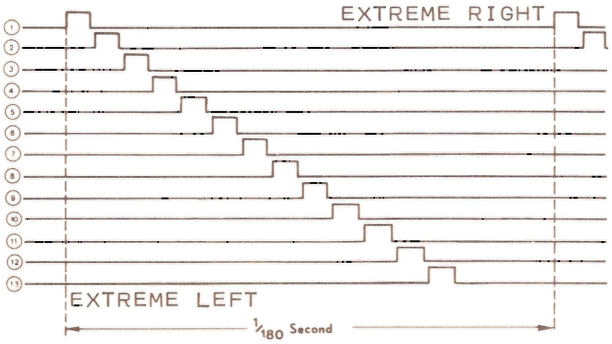


FIG 29: SCANNING THE DISPLAY

As mentioned, to illuminate any character two things must occur simultaneously. First, the character position must be selected (scanned) and, second, the segments to form that character must be selected.

Assume an eight with decimal point (8.) is to be displayed in the second character position of the tube (see figure 30). The MOS device will begin to scan at the first character position and scan to the left. As the second character position is reached notice that the segments A, B, C, D, E, F, G and DP have been switched. Because the signals occured simultaneously (the grid and all segments), (8.) will appear at the second position. Keep in mind that this occured in a fraction of 1/180th of a second. Immediately the segments begin to darken, but in the next 1/180th of a second, the MOS device will perform the same operation. To the eye this light appears to be constant. The process is called multiplexing.

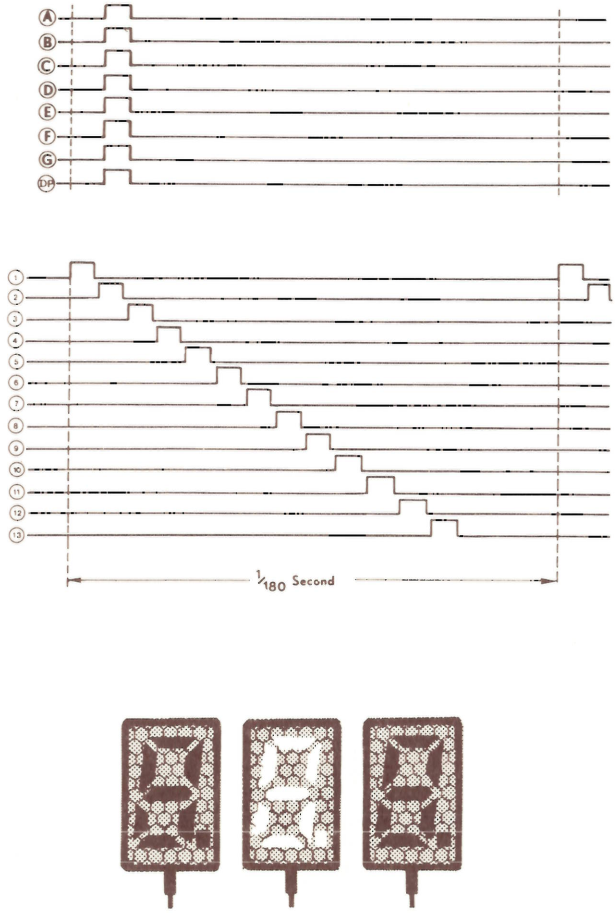


Fig 30: signals for (8.) display

To further illustrate, assume that the entry (-12.34) is to be displayed at the extreme right of the display in positions one through five as shown below. As mentioned, the display is scanned 180 times per second, right to left (least significant digit-to-most significant digit). Considering just one scan of the entry (-12.34), at position one the MOS device will recognize that a character is to be formed. It will switch the grid as usual, and it will also switch the B,C,F and G segments to form a (4). At the second position a (3) is required, so segments A,B,C,D and G will be switched along with the grid, forming a (3). As this character is switched off, the scan proceeds to the third position to form (2.). All segments except C and F must be switched. The character lights, then is switched off as the scan proceeds to position four to form a (1). Segments B and C are switched along with the grid, then switched off as the scan proceeds to the fifth position to form a minus sign: segment G. The minus sign will appear, then the scan proceeds to the next position. The grid will be scanned (switched) as usual but no segments will be switched, thus no character will appear. Similarly, the rest of the grids will be scanned but no segments, so no characters will appear. Keep in mind that at the rate at which this occurs the light seems to be constant.

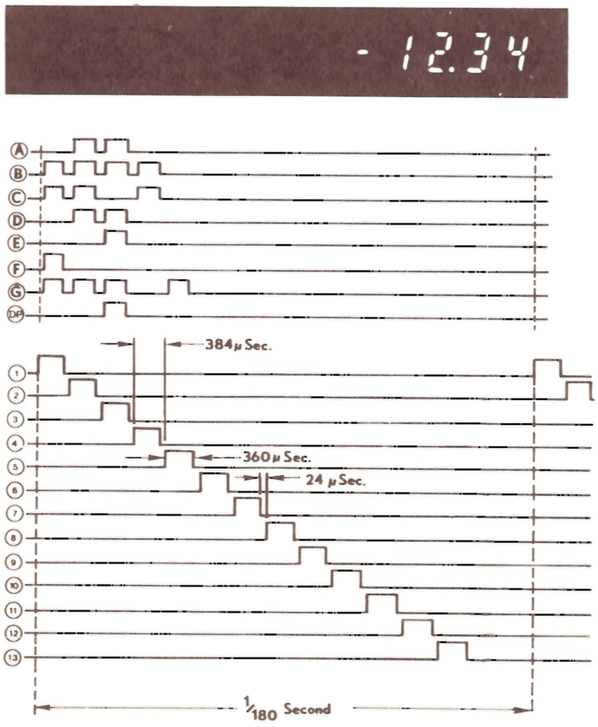


Fig 31: scanning the entry -12.34

DIAGNOSTIC PROCEDURE

POWER SUPPLY FAULTS

IF THE FAULT IS OBVIOUSLY IN THE POWER SUPPLY, REMOVE AND CHECK THE TRANSFORMER GROUP AND THE CONNECTORS TO THE E.C.U./KEYBOARD MODULE. IF THIS GROUP IS SATISFACTORY CHECK THE DISCRETE COMPONENTS ON THE E.C.U.

DISPLAY FAULTS

BECAUSE THE DISPLAY TUBE IS SEALED, AND THE CABLE CONNECTORS ARE NOT TO BE DISASSEMBLED, THE ENTIRE DISPLAY MODULE IS TO BE REPLACED IF FAULTY.

PRINTER AND KEYBOARD FAULTS

PROBLEMS IN THE PRINTER OR THE KEYBOARD ARE TO BE CORRECTED BY THE SERVICEMAN. THESE MODULES MAY BE REPLACED IN THE FIELD AND REPAIRED LATER FOR USE AS SPARE PARTS. PRINTERS AND KEYBOARDS ARE NOT TO BE SENT TO THE LAB.

FAULTS RELATED TO THE E.C.U.

BECAUSE OF THE COMPLEXITY OF THE E.C.U. AND THE ELECTRICAL DELICACY OF THE MOS-LSI CHIPS, THE MOS DEVICES ARE NOT TO BE REPLACED BY BRANCH PERSONNEL. IN THIS CASE SEND THE E.C.U. TO THE LAB. SEND ONLY THE E.C.U. TO THE LAB; DO NOT SEND THE ENTIRE MACHINE.

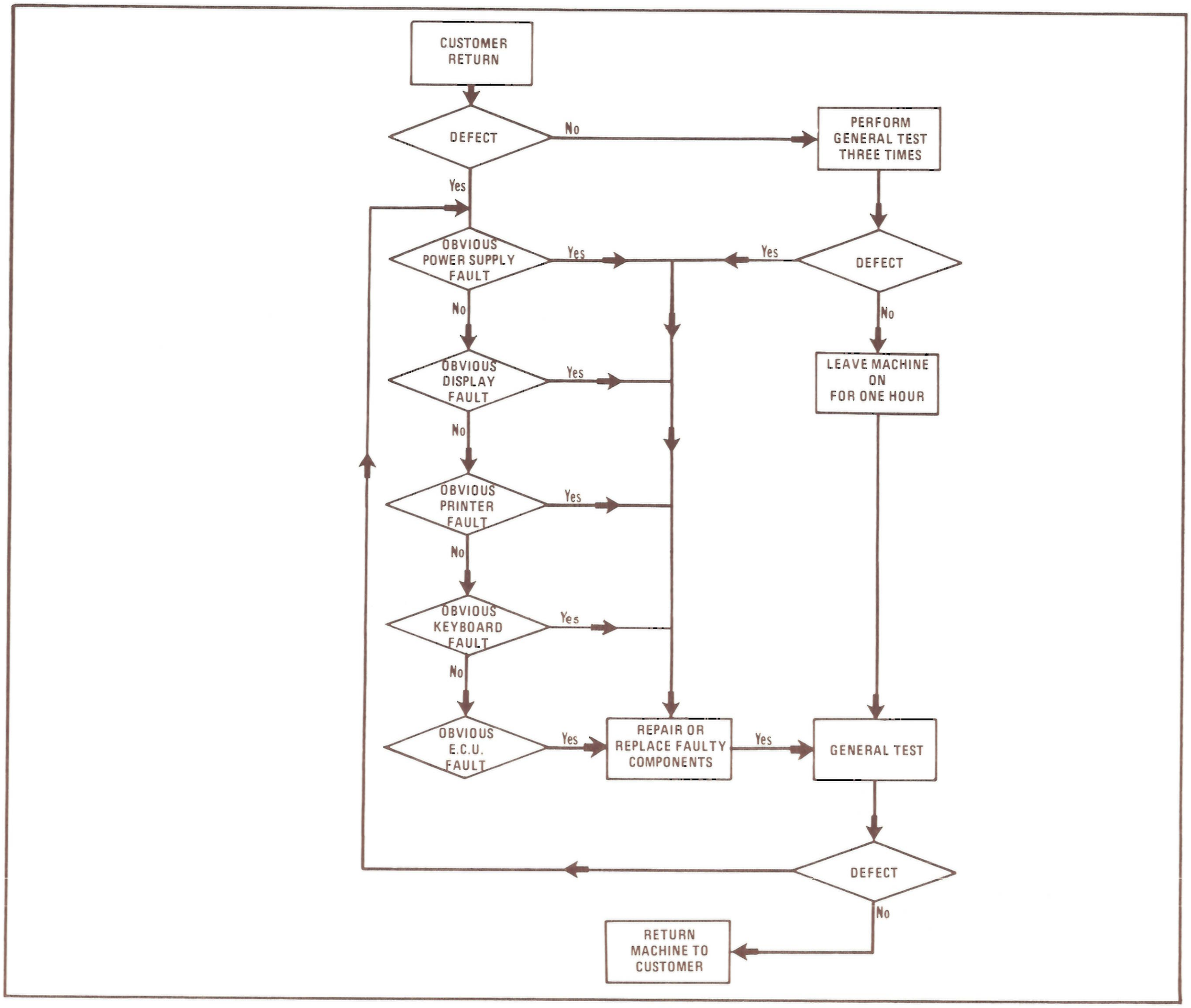


FIG 32

1L
FAULT-FINDING GUIDE

The power supply consists of the transformer module and most of the discrete components on the logic board (E.C.U.).

The separable transformer module consists of the transformer, main AC switch, fuse, connector and housing, and AC receptacle. The transformer produces 38 VAC (approx) to be rectified and filtered for electronic and printer voltages, and a separate 3.8 VAC source for the filament of the display tube.

Sections on the E.C.U. are shown below, and are described along with the voltages they produce, as follows:

VCF nominal +38 VDC, is the rectified but unfiltered DC source from which the others are derived, and it originates in the area indicated.

VGG (zero volts, or system ground) also originates at the rectifier.

VSS is the voltage that powers the electronics and furnishes Power-On Initialize, and is produced in the area shown. VSS is approximately +10 VDC.

VPR powers the printer at +18 VDC, also a nominal voltage; in fact, VPR must be adjusted for optimum printing speed.

VDISP (-20.0 VDC) is the negative voltage to the character grids and segments of the display tube.

The following is a list of possible power supply faults and their probable causes. System ground is VGG: 0 VDC.

No VCF: fuse blown in transformer group
: bad transformer windings
: bad AC connection
: diode D000/1,2,3 or 4 open

No VSS: voltage regulator LM342/10 bad

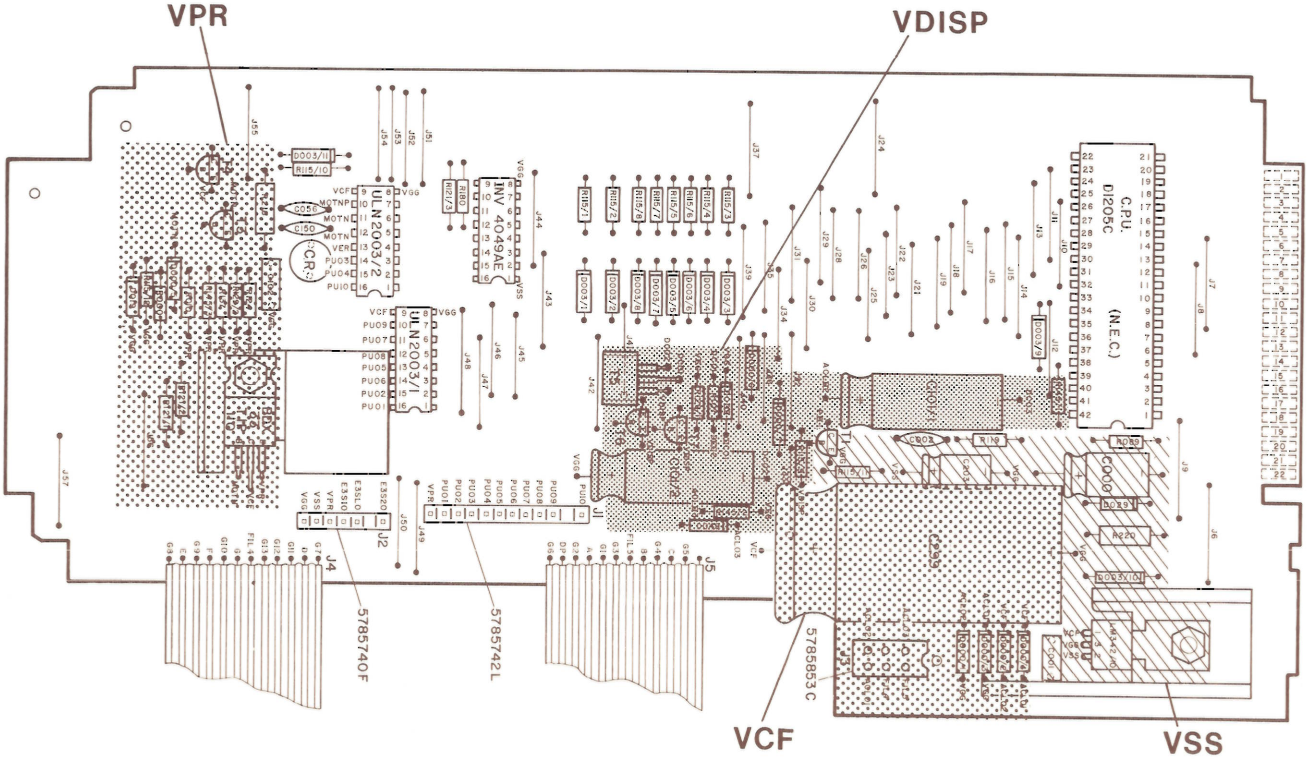
No VPR: voltage regulator BDX33 bad
: transistor T3 or T4 bad

VPR greater than +24 VDC
: transistor T3 bad

No VDISP: transistor T5 bad

VDISP less than -20.0 VDC
: diode D000/6 or 7, D009 or D049 shorted

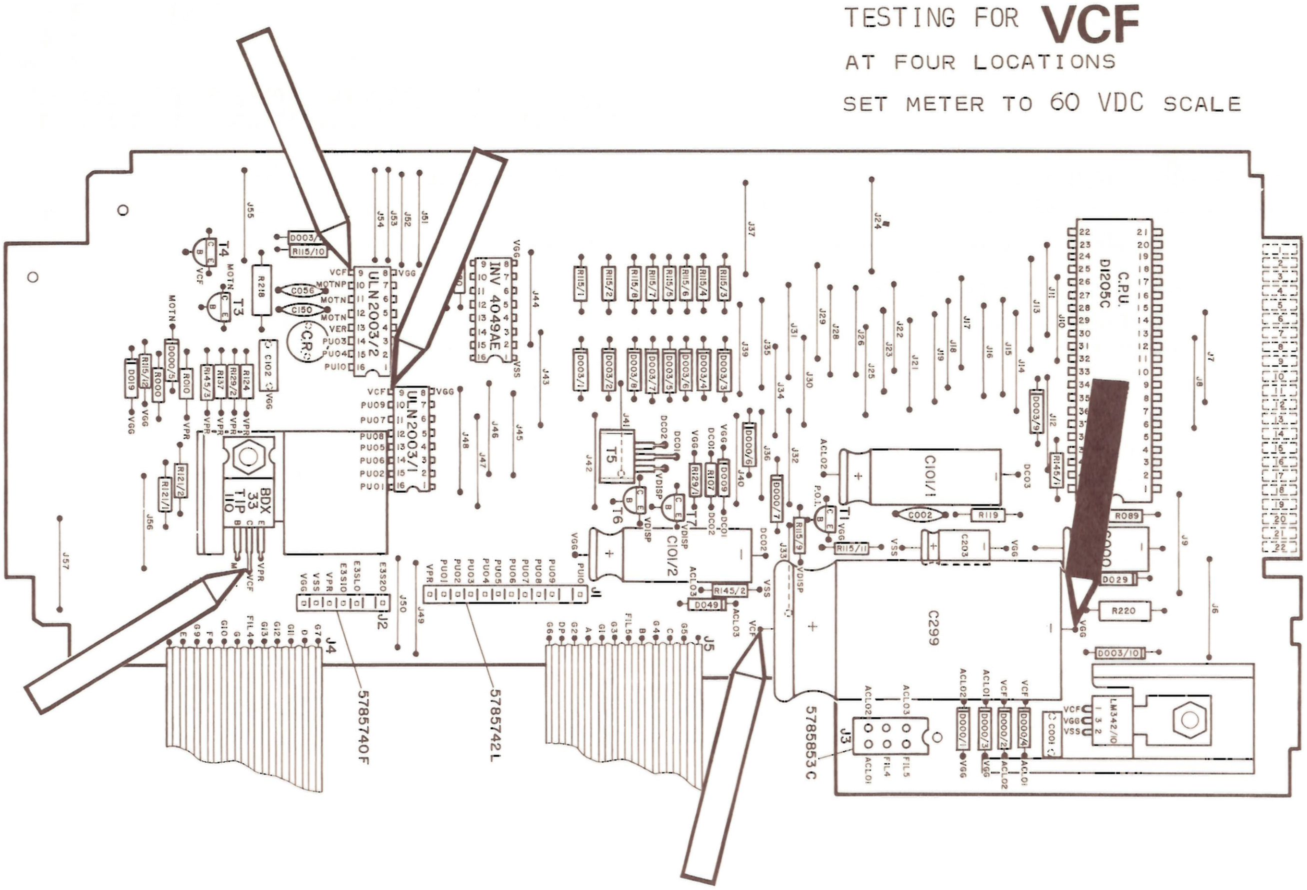
When making voltage checks, always use VGG (0 VDC) as reference or system ground as indicated on the following pages. Note that when checking VDISP you must reverse the probes.



TESTING FOR **VCF**

AT FOUR LOCATIONS

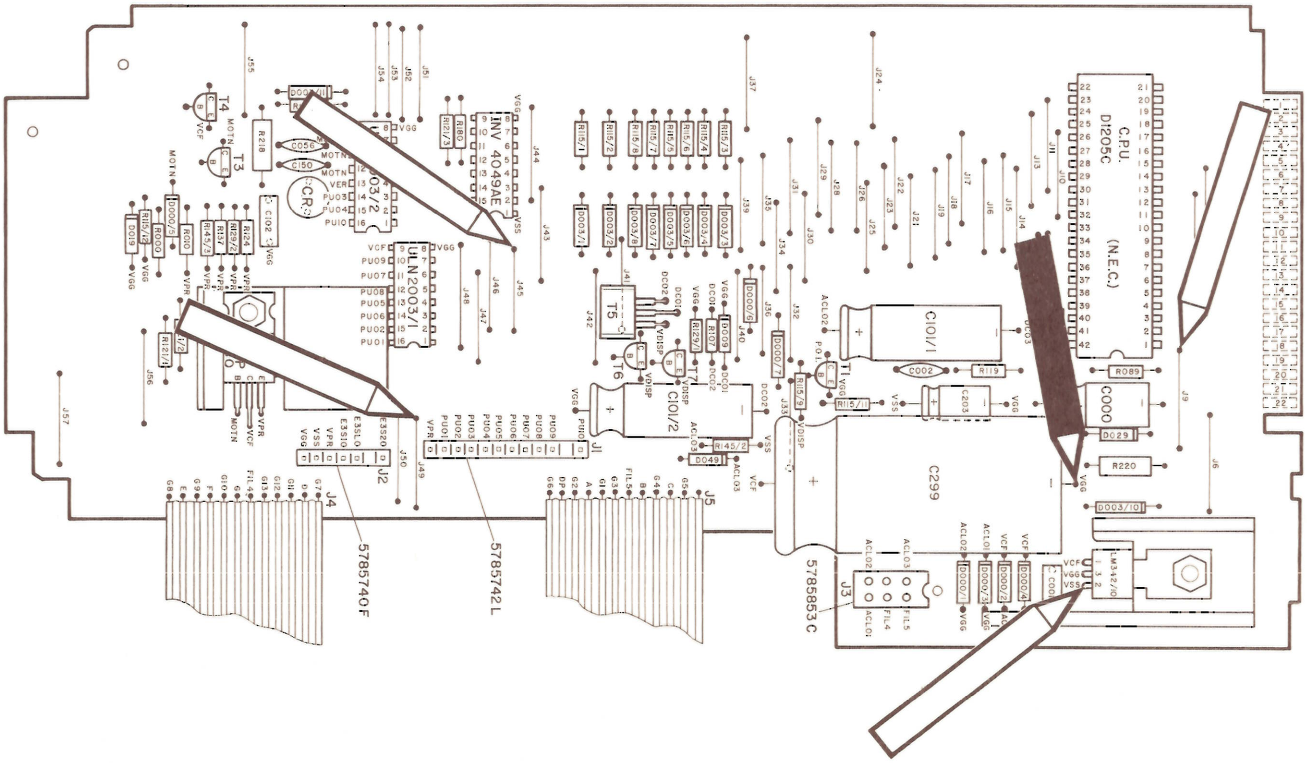
SET METER TO 60 VDC SCALE



TESTING FOR **VSS**

AT FOUR LOCATIONS

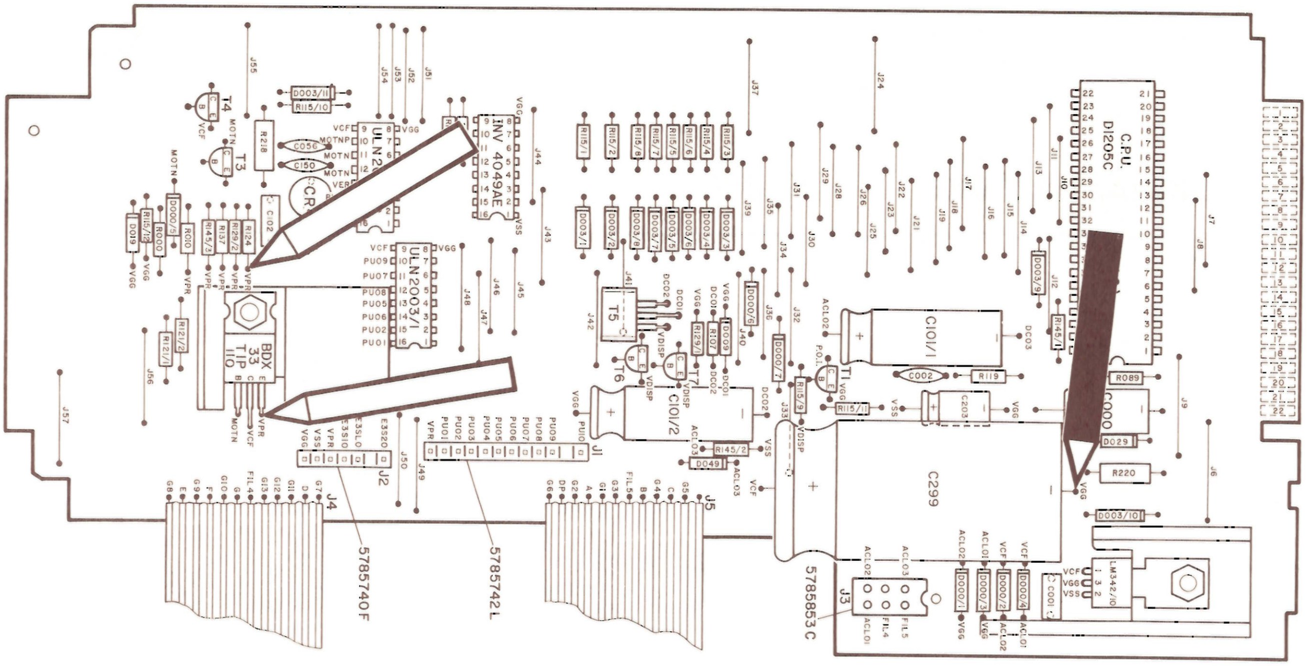
SET METER TO 60 VDC SCALE



TESTING FOR **VPR**

AT TWO LOCATIONS

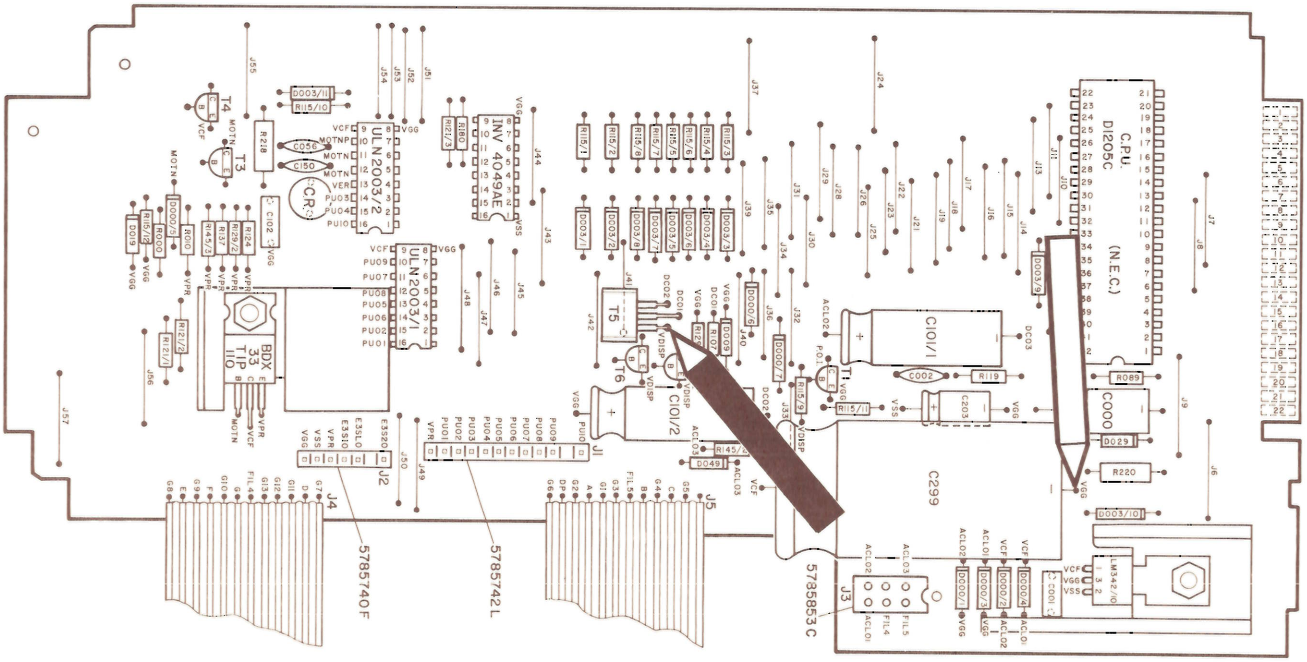
SET METER TO 60 VDC SCALE



TESTING FOR **VDISP**

SET METER TO 60 VDC SCALE

AND REVERSE PROBES*



* VDISP IS A NEGATIVE VOLTAGE

DISPLAY FAULTS

MISSING SIGNALS TO DISPLAY TUBE

	SIGNAL MISSING	FAULT
CONNECTOR J5	G5	NO CHARACTER DISPLAY IN 5TH POSITION
	C	ALL C SEGMENTS DO NOT ILLUMINATE
	G4	NO CHARACTER DISPLAY IN 4TH POSITION
	B	ALL B SEGMENTS DO NOT ILLUMINATE
	FIL5	NO CHARACTER DISPLAY IN ANY POSITION
	G3	NO CHARACTER DISPLAY IN 3RD POSITION
	G1	NO CHARACTER DISPLAY IN 1ST POSITION
	A	ALL A SEGMENTS DO NOT ILLUMINATE
	G2	NO CHARACTER DISPLAY IN 2ND POSITION
	DP	ALL DECIMAL POINTS DO NOT ILLUMINATE
	G6	NO CHARACTER DISPLAY IN 6TH POSITION
CONNECTOR J4	G7	NO CHARACTER DISPLAY IN 7TH POSITION
	D	ALL D SEGMENTS DO NOT ILLUMINATE
	G11	NO CHARACTER DISPLAY IN 11TH POSITION
	G12	NO CHARACTER DISPLAY IN 12TH POSITION
	G13	NO CHARACTER DISPLAY IN 13TH POSITION
	FIL4	NO CHARACTER DISPLAY IN ANY POSITION
	G	ALL G SEGMENTS DO NOT ILLUMINATE
	G10	NO CHARACTER DISPLAY IN 10TH POSITION
	F	ALL F SEGMENTS DO NOT ILLUMINATE
	G9	NO CHARACTER DISPLAY IN 9TH POSITION
	E	ALL E SEGMENTS DO NOT ILLUMINATE
	G8	NO CHARACTER DISPLAY IN 8TH POSITION

MECHANICAL PRINTER FAULTS

DEFECT	PROBABLE CAUSE
ALL CHARACTERS PRINT LIGHT	RESET SHAFT ADJUSTMENT INCORRECT; VERTICAL ALIGNMENT ADJUSTMENT INCORRECT.
MOTOR RUNS, NO PRINT	RESET SHAFT ADJUSTMENT INCORRECT; VERTICAL ALIGNMENT ADJUSTMENT INCORRECT.
TOO MANY DOTS, OR DOTS BETWEEN LINES	BOBBIN SUPPORT ADJUSTED TOO FAR FROM PLATEN; MAGNETIC RUBBER FAULTY; RESET SPRING BROKEN OR BENT.
PRINTER JAMS OR WON'T MOVE	BOBBIN SUPPORT ADJUSTED TOO CLOSE TO PLATEN; MAIN CONTROL CAM-TO-RESET SHAFT BINDING; FOREIGN MATERIAL IN POWER TRAIN; MOTOR-TO-IDLE GEAR BINDING.
DOTS MISSING FROM CHARACTER EDGES	VERTICAL ALIGNMENT ADJUSTMENT INCORRECT.
ONE OR TWO CHARACTERS MISSING FROM LINE	PRINT NEEDLE BROKEN OR BINDING IN NEEDLE GUIDE.
ONE OR TWO CHARACTERS MISSING OR LIGHT	BROKEN OR BENT PRINT SPRING FOR RESPECTIVE ANCHOR-AND-NEEDLE.
SOLID MATRIX, ALL DOTS PRINT	FAULTY MAGNETIC RUBBER; BOBBIN SUPPORT ADJUSTED TOO FAR FROM PLATEN.

ELECTRONIC PRINTER FAULTS

DEFECT	PROBABLE CAUSE
TOO MANY DOTS, OR DOTS BETWEEN LINES	FAULTY BOBBIN. *
PRINTER WON'T MOVE	VGG OR VPR ABSENT
ONE OR TWO CHARACTERS MISSING FROM LINE	FAULTY BOBBIN; * BROKEN WIRE FROM J1 TO BOBBIN; ABSENT BOBBIN SIGNAL: PU01N THROUGH PU10N.
PRINTER RUNS CONTINUOUSLY, NO PRINT OR FAULTY PRINT	ABSENCE OF E3S10 FROM STROBE; ABSENCE OF VSS TO PRINTER; ABSENCE OF E3SL0 OR E3S20.
PRINTER RUNS NORMALLY, NO DOTS PRINT	ABSENCE OF VPR TO BOBBIN ASSEMBLY.

* To VERIFY AN INDIVIDUAL BOBBIN, SET THE METER TO Rx1; PLACE ONE PROBE IN VPR OF CONNECTOR J1 AND THE OTHER PROBE ON THE BOBBIN SIGNAL WIRE TO BE TESTED. RESISTANCE SHOULD BE APPROXIMATELY 50-TO-60 OHMS. IF THERE IS NO CONTINUITY READING ON AN INDIVIDUAL BOBBIN, THEN IT MUST BE CONSIDERED OPEN AND UNABLE TO ENERGIZE. IF THE METER INDICATES A SHORT, THE POSSIBILITY EXISTS THAT NOT ONLY IS THE BOBBIN SHORTED AND UNABLE TO ENERGIZE, BUT THAT IT HAS CAUSED ONE OF THE IC DRIVERS TO SHORT AS WELL. IF A SHORTED BOBBIN MUST BE REPLACED CHECK THE IC DRIVER FIRST, AS INSURANCE THAT THE REPLACEMENT BOBBIN WON'T BE DAMAGED BY A SHORTED DRIVER.

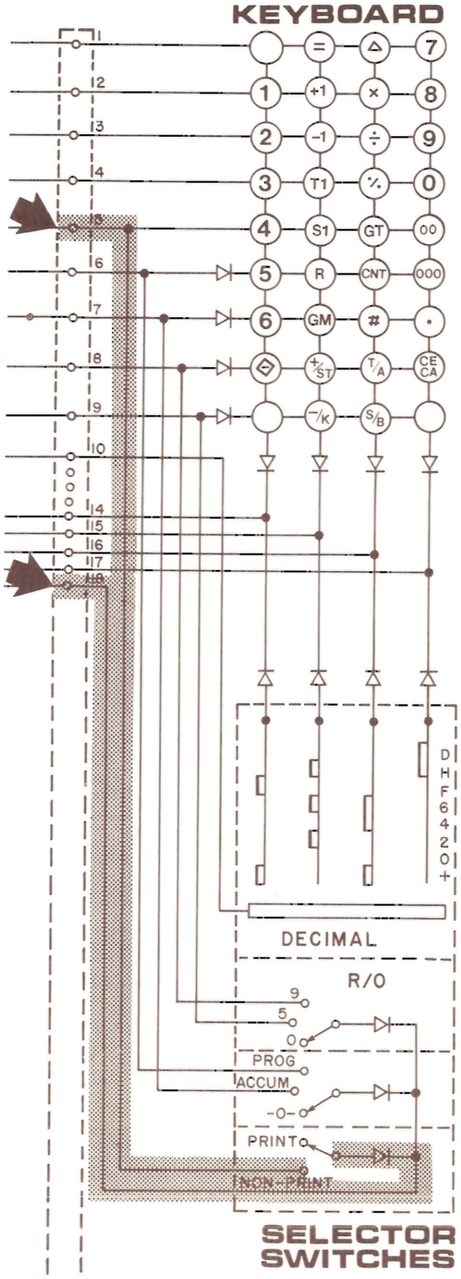
MAGNETIC RUBBER VERIFICATION

REMOVE THE ADJUSTING ECCENTRICS FROM THE BOBBIN SUPPORT AND REMOVE THE RUBBER, SUPPORT AND BOBBIN ASSEMBLY. HOLD THE BOBBIN ASSEMBLY-AND-SUPPORT WITH THE ENDS OF THE SUPPORT UP; THE STRAIGHT THIN EDGE OF THE RUBBER SHOULD SUPPORT THE WEIGHT OF THE GROUP WHEN TOUCHED TOGETHER. IF IT DOESN'T REPLACE THE RUBBER.

KEYBOARD FAULTS

KEYSWITCH VERIFICATION

To verify an individual keyswitch, set the meter to Rx1 scale; place one probe on each of the two keyswitch contacts on the underside of the keyboard module. Activate the keyswitch: 0 Ohms (continuity) should register. If not, replace the keyswitch.



KEYSWITCH REMOVAL

De-solder the two contacts on the keyswitch to be removed. Remove it from top of keyboard module. Install new keyswitch by inserting and soldering.

SELECTOR SLIDER VERIFICATION

Set meter to Rx1 scale.

When verifying the selector sliders, keep in mind that it is possible to read discontinuity because of the diodes in the keyboard itself. These diodes prevent incorrect keyboard scanning by the MOS devices by ensuring that current flows in only one direction. You must be sure that the meter's probes are in correct phase with respect to the anode and cathode of the diode(s). Check all diodes: the meter should show approximately 150 to 170 Ohms.

The technician should refer to the wiring schematic, which corresponds to the keyboard at the laminar connector. Place the meter probes on the tracks of the selector to be tested, and switch the slider from position to position; this should reveal closed and open conditions:

For example, testing the Print/Non-Print switch in the Print position, place the probes on tracks 5 and 18, and move the slider from Non-Print to Print and back. With the slider operating properly, and the probes placed correctly, the meter should show approximately 150 to 170 Ohms in the Non-Print position, and discontinuity in the Print position.

SLIDER CONTACT REPLACEMENT AND CLEANING

De-solder the sixteen connections from the keyboard PC board to the selector slider PC board. Remove the three screws and remove the selector slider group. Slide the PC board away from the bracket; all contacts are now accessible. Clean or replace as required. Reassemble by reversing the above procedure.

IMPORTANT

DO NOT ATTEMPT TO REMOVE THE SLIDERS BY ANY OTHER PROCEDURE: YOU WILL ONLY BREAK THE SLIDER PC BOARD AND THEN HAVE TO REPLACE IT.

FAULTS BETWEEN KEYBOARD AND E.C.U.

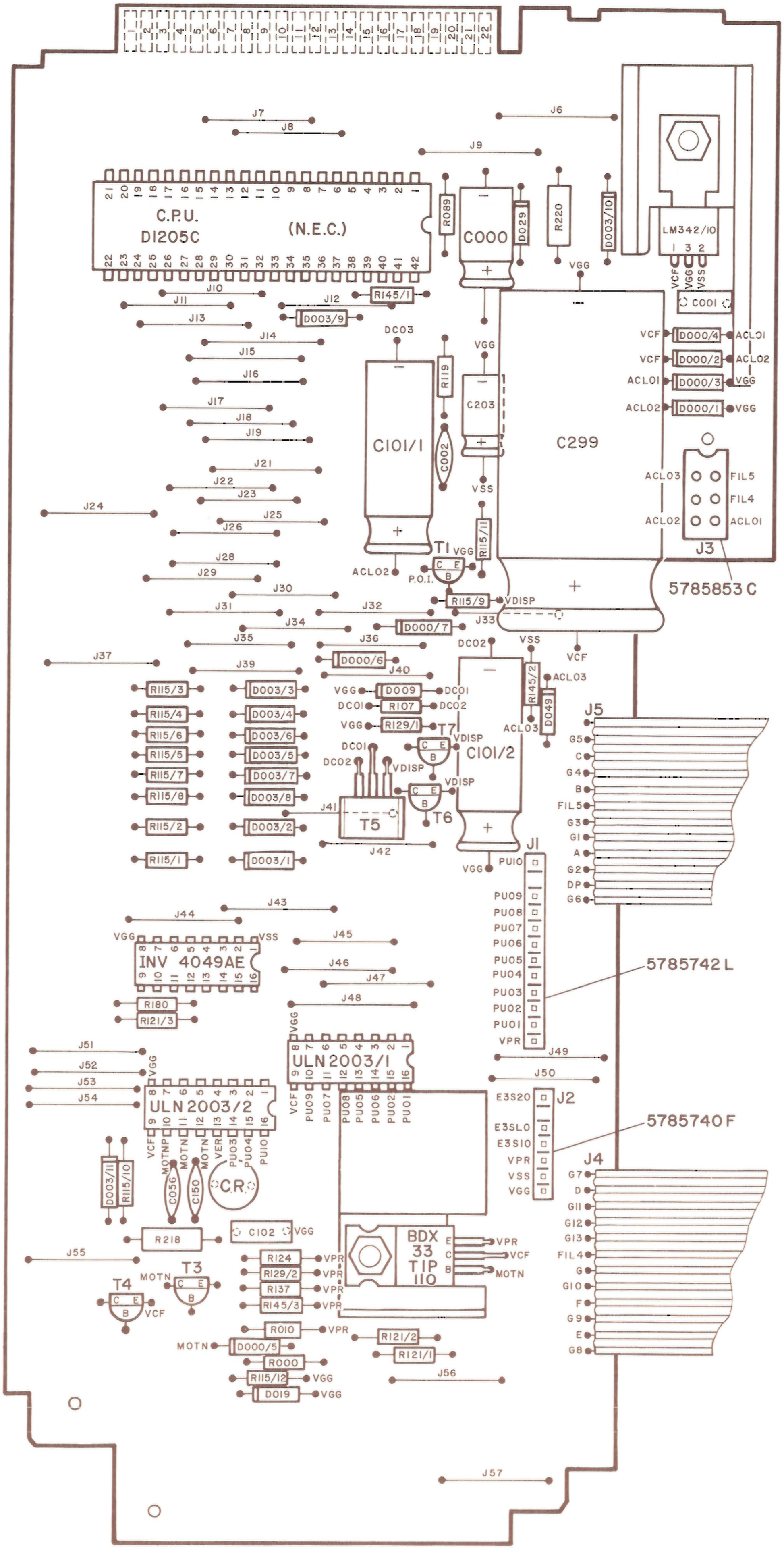
VIA BOARD-TO-BOARD CONNECTOR

(BAD EXTERNAL CONTACTS)

DEFECT: (THE FOLLOWING DO NOT OPERATE)	POS.
−2/K, S2/B	1
⊖, +2/ST, T2/A, CE:CA	2
6, GM, #, ⊙	3
5, R, CNT, 000	4
4, S1, GT, 00 KEYS; NON-PRINT	5
3, T1, %, 0 KEYS; PROG*	6
2, −1, ÷, 9 KEYS; ACC	7
1, +1, X, 8 KEYS; R/0 @ 9	8
=, △, 7 KEYS; R/0 @ 5	9
ALL DECIMALS SAME AS 0 SETTING	10
NO EFFECT	11
NO EFFECT	12
NO EFFECT	13
1,2,3,4,5,6,⊖ KEYS; DECIMAL @ +, FL	14
=,+1,−1,T1,S1,R,GM,+2/ST,−2/K KEYS; DECIMAL @ 2, 6, H	15
△,X,÷,%,GT,CNT,#,T2/A,S2/B KEYS; DECIMAL @ +, 4, 6	16
7,8,9,0,00,000,⊙, CE:CA KEYS; DECIMAL @ H, D	17
NON-PRINT; ACC, PROG*; R/0 @ 5,9	18
NO EFFECT	19
NO EFFECT	20
NO EFFECT	21
NO EFFECT	22

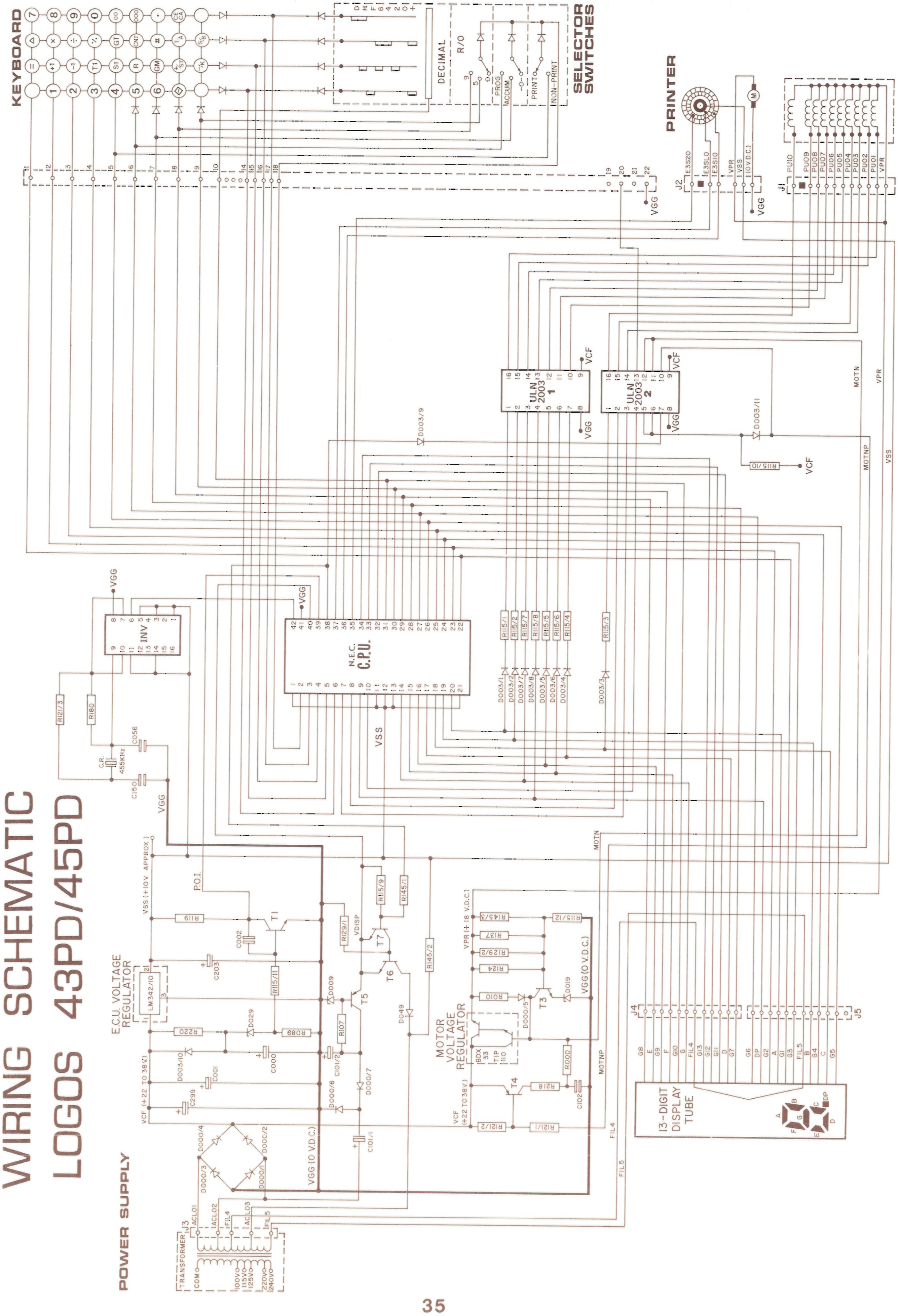
* LOGOS 45PD ONLY.

E.C.U. LAYOUT
LOGOS 43 PD/45 PD



466.38.2

WIRING SCHEMATIC
LOGOS 43PD/45PD

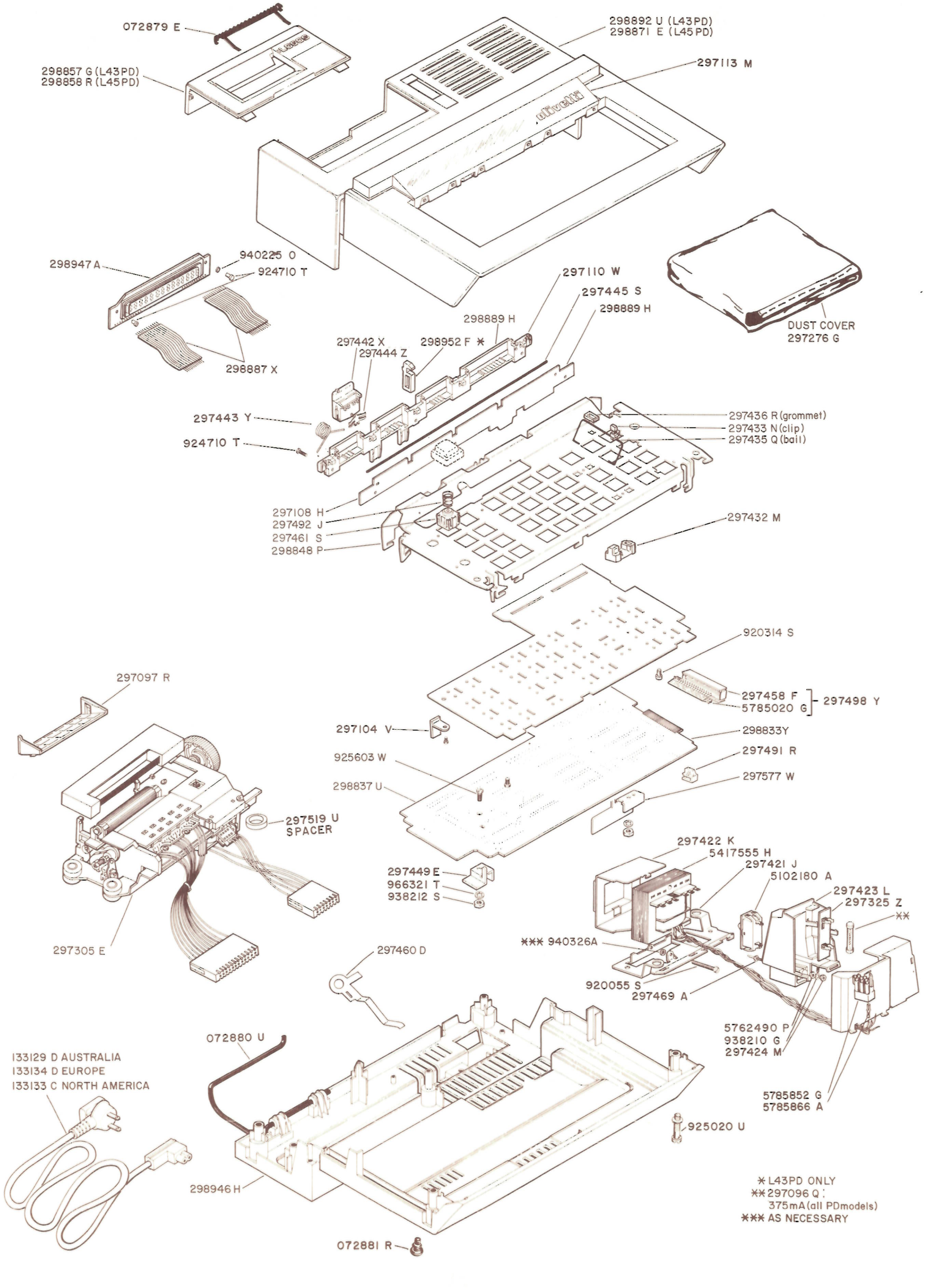


466-38-2

ELECTRONIC COMPONENTS LIST

CODE	PART NUMBER	IDENTIFICATION
CPU	4863990 V	(NEC) D1205C
LM342/10	4855810 B	VOLTAGE REGULATOR
BDX33	4846776 F	NPN DARLINGTON VOLT REG
ULN2003/1,2	4853803 E	IC DRIVERS
C.R.	4874655 J	CERAMIC RESONATOR 455 KHZ
INV	4866008 A	CMOS INVERTER 4049AE
T1, 3, 6, 7	4849504 V	NPN TRANS: BC237B
T4	4848504 Z	PNP TRANS: BC307B
T5	4437497 Z	PNP TRANS: RCP704B
D000/1-7	4800230 M	1N4002 DIODE
D019	4801112 X	1N753A ZENER
D049	4801113 T	1N751A ZENER
D029	4801138 K	1N966B ZENER
D003/1-11	4801500 D	1X8055 DIODE
D009	4814713 Z	1N968B ZENER
(RESISTORS ARE ¼W UNLESS SPECIFIED)		
R010	4912043 G	10 OHM
R000	4922350 N	22 OHM
R089	4923710 W	470 OHM
R107	4924470 K	2.7 KOHM
R115/1-12	4924778 Q	5.6 KOHM
R180	4927050 W	1 MEGOHM
R119	4924938 H	8.2 KOHM
R121/1-3	4925058 M	10 KOHM
R124	4925170 H	13 KOHM
R129/1,2	4925370 D	22 KOHM
R137	4925690 V	47 KOHM
R145/1-3	4926058 Z	100 KOHM
R220	4934131 B	1.2 KOHM, ½W
R218	4944056 S	1.0 KOHM, ½W
C001	5005197 L	.047 uF (FILM)
C102	5005221 T	0.1 uF (FILM)
C203	5037454 E	10 uF @ 25V
C101/1,2	5041960 L	100 uF @ 50V
C299	5054943 Z	3300 uF @ 40V
C000	5056312 D	10 uF @ 50V
C056	5070871 N	56 pF (CERAMIC)
C150	5070886 G	150 pF (CERAMIC)
C002	5070904 S	470 pF (CERAMIC)
—	298837 U	COMPLETE E.C.U. (NEC)
—	297498 V	BOARD-TO-BOARD CONNECTOR

UNIT PARTS LIST

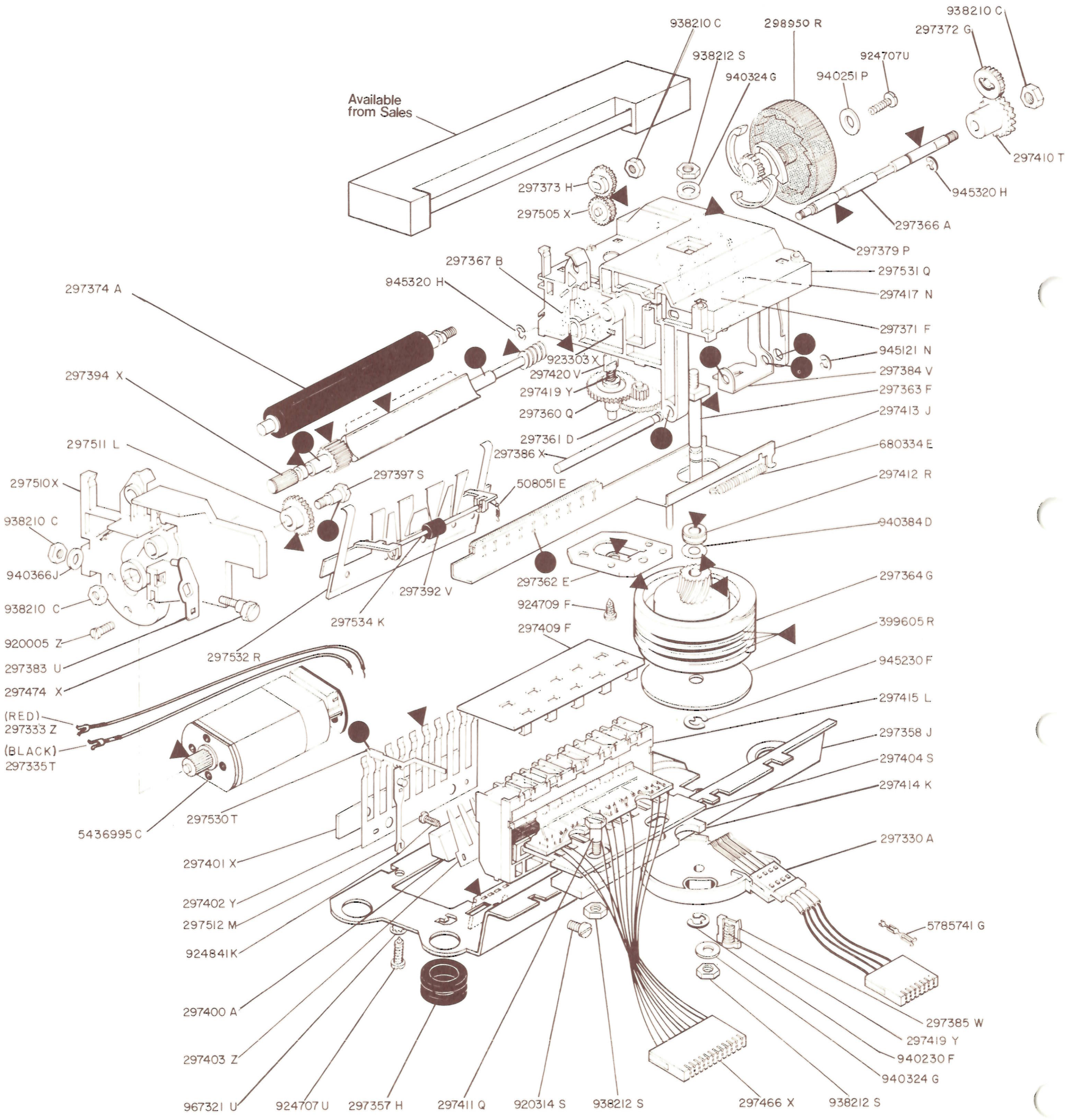


* L43PD ONLY
** 297096 Q :
375mA (all PD models)
*** AS NECESSARY

PRINTER PARTS LIST

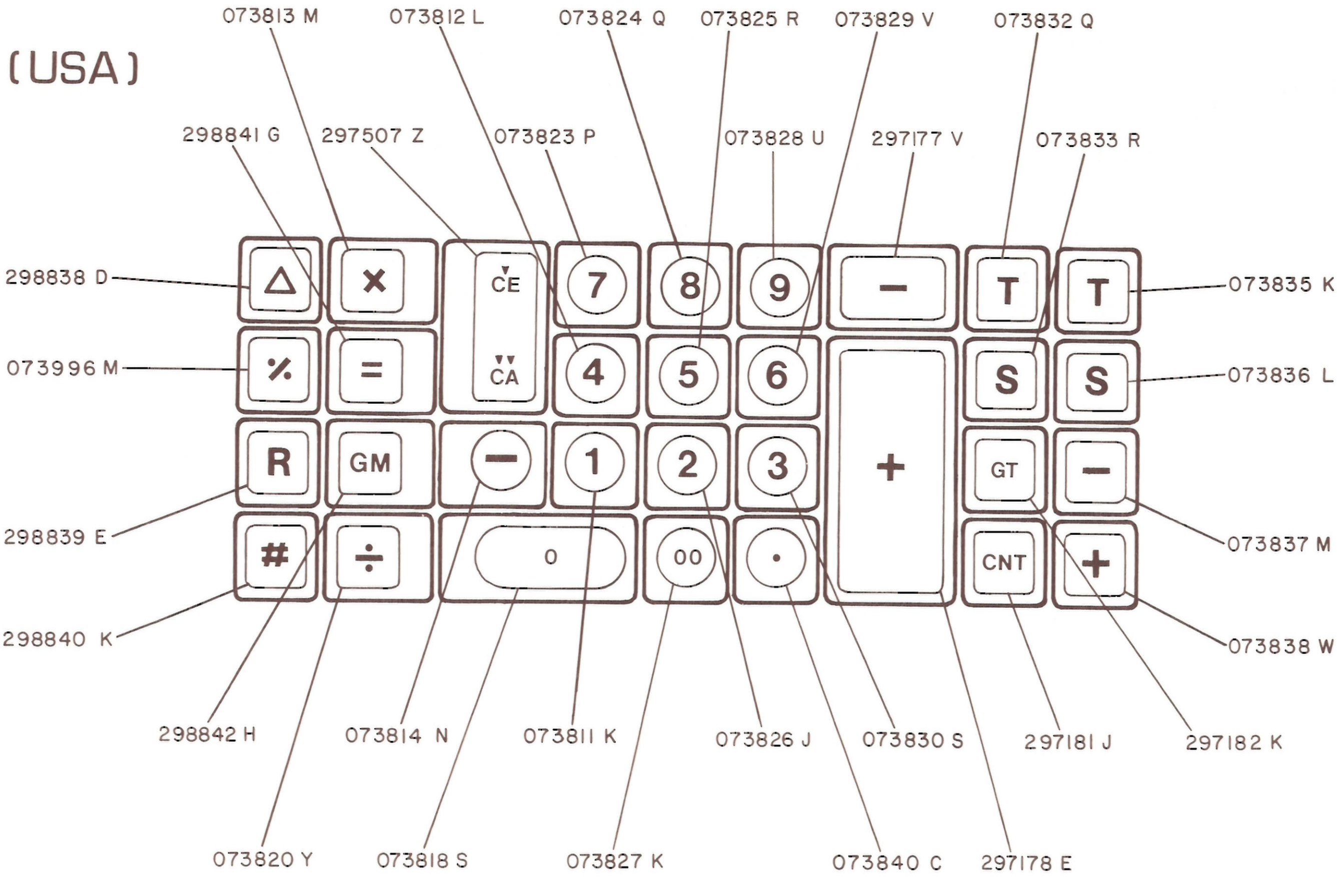
LUBRICATION POINTS — USE SMALL AMOUNTS OF LUBRICANT

▲ = LUBRICATE WITH GREASE ● = LUBRICATE WITH OIL

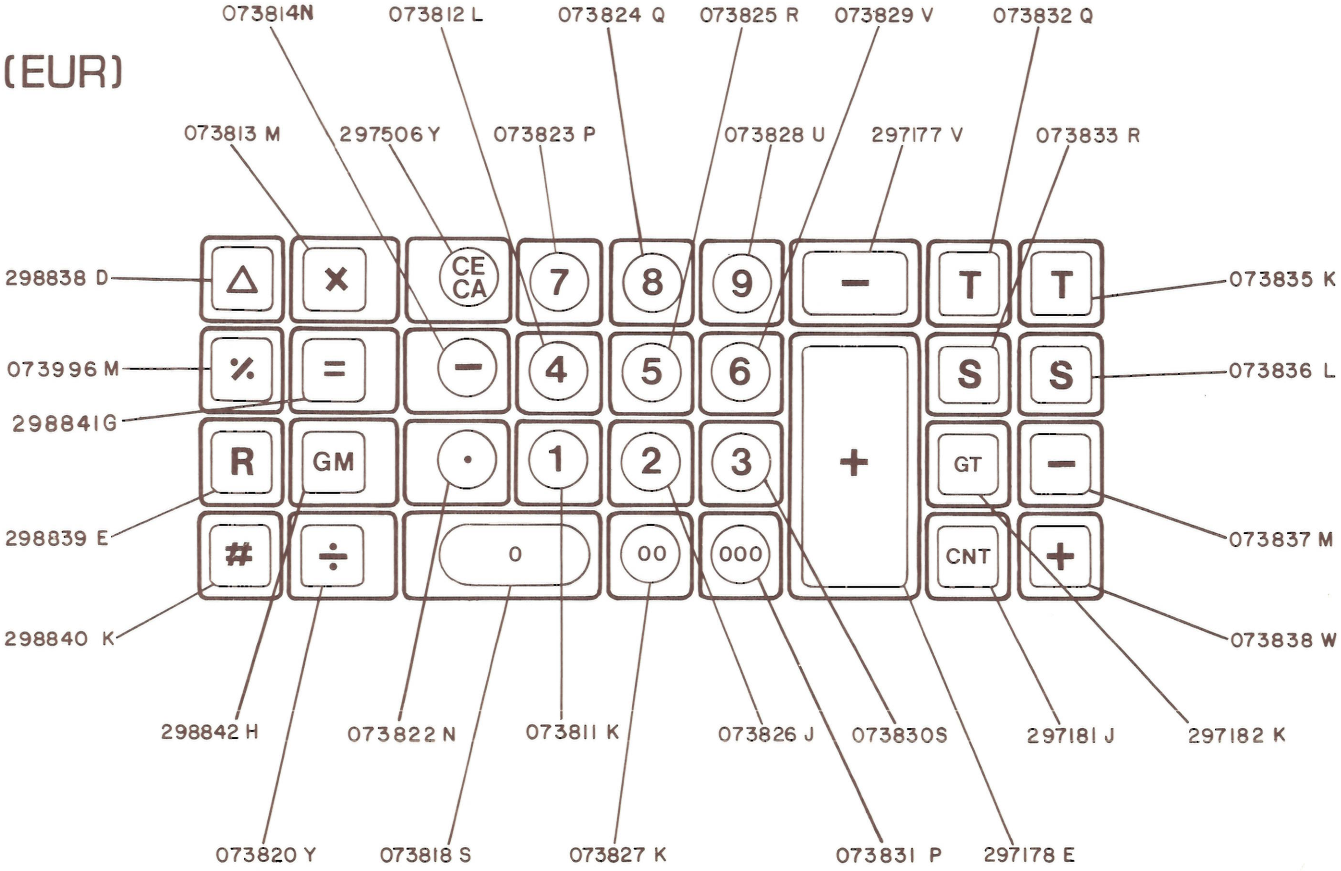


KEYTOPS LIST

(USA)

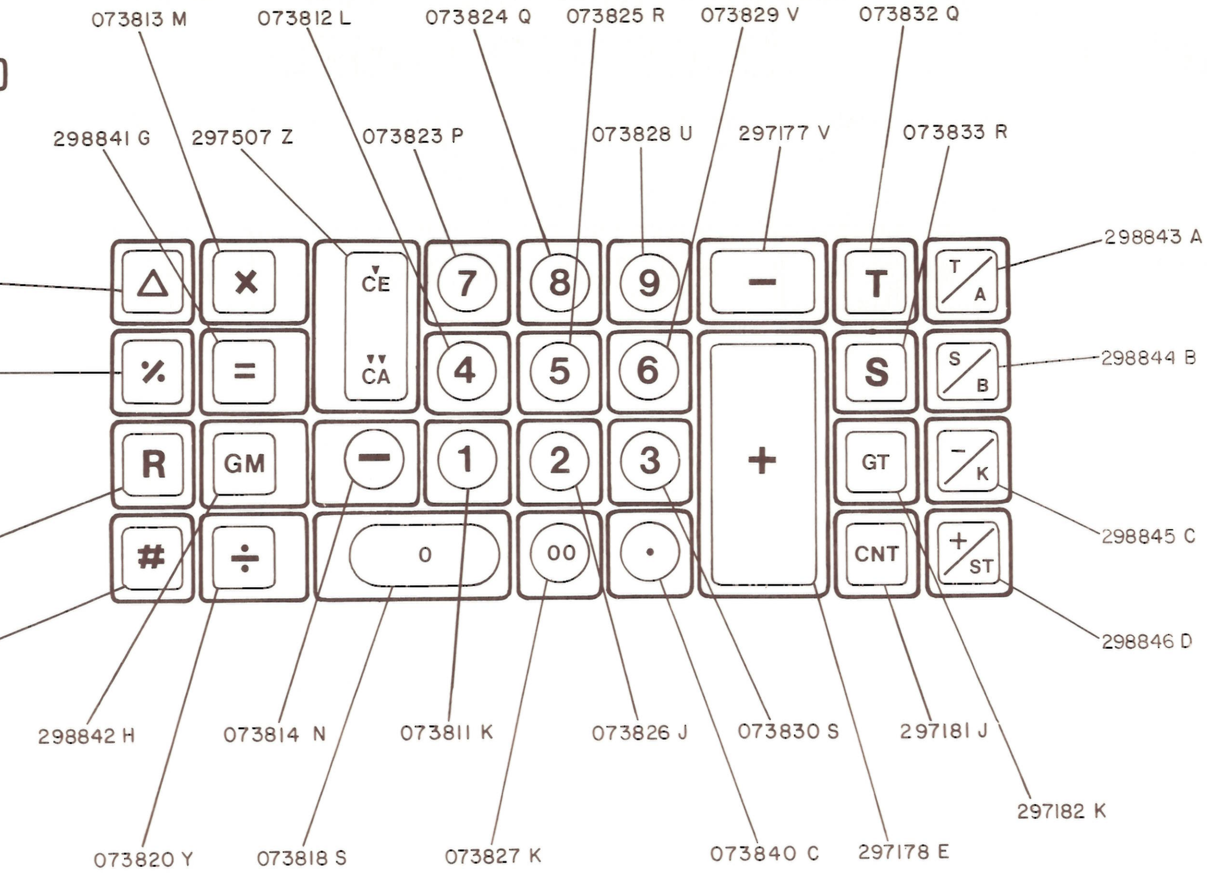


(EUR)

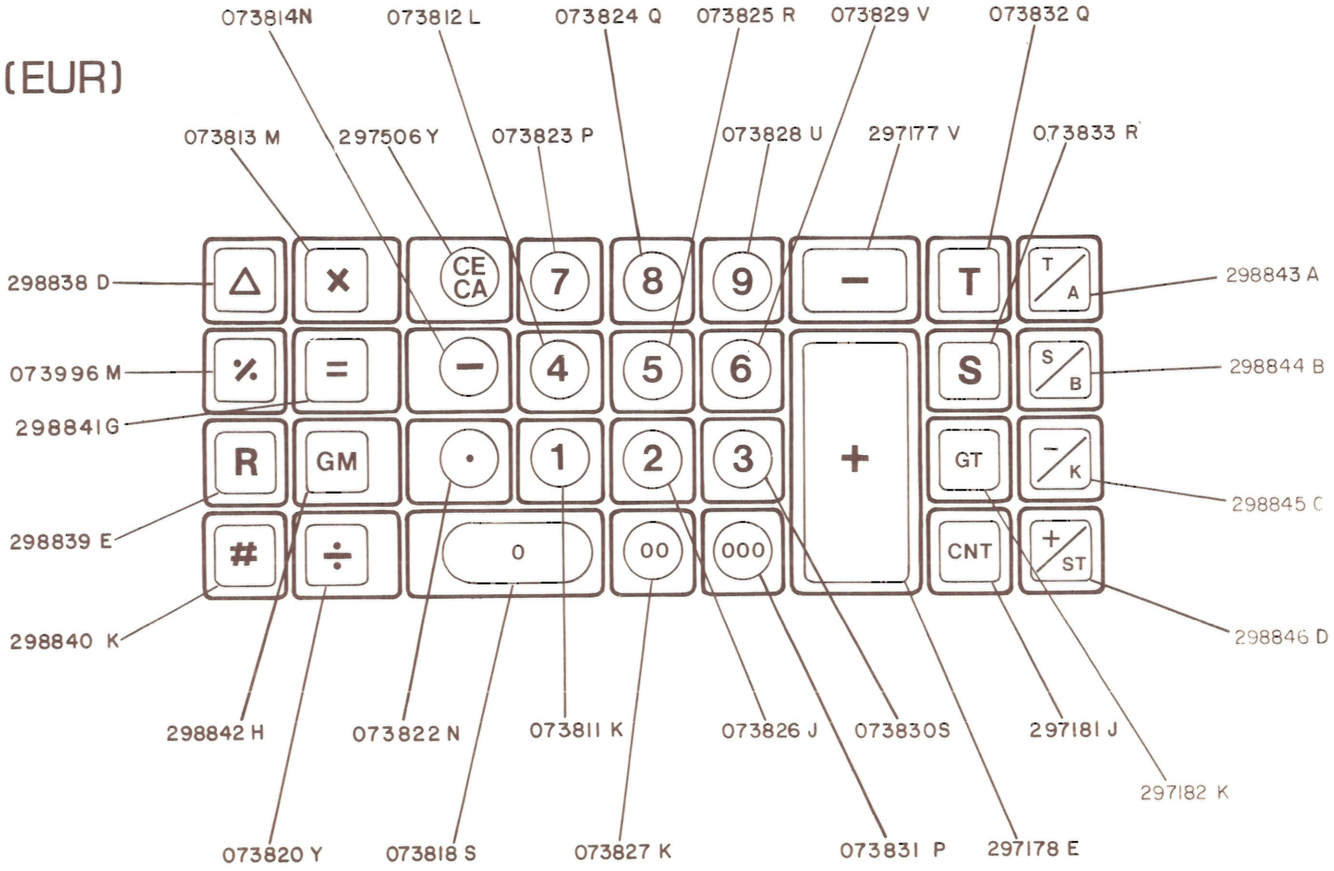


KEYTOPS LIST

(USA)

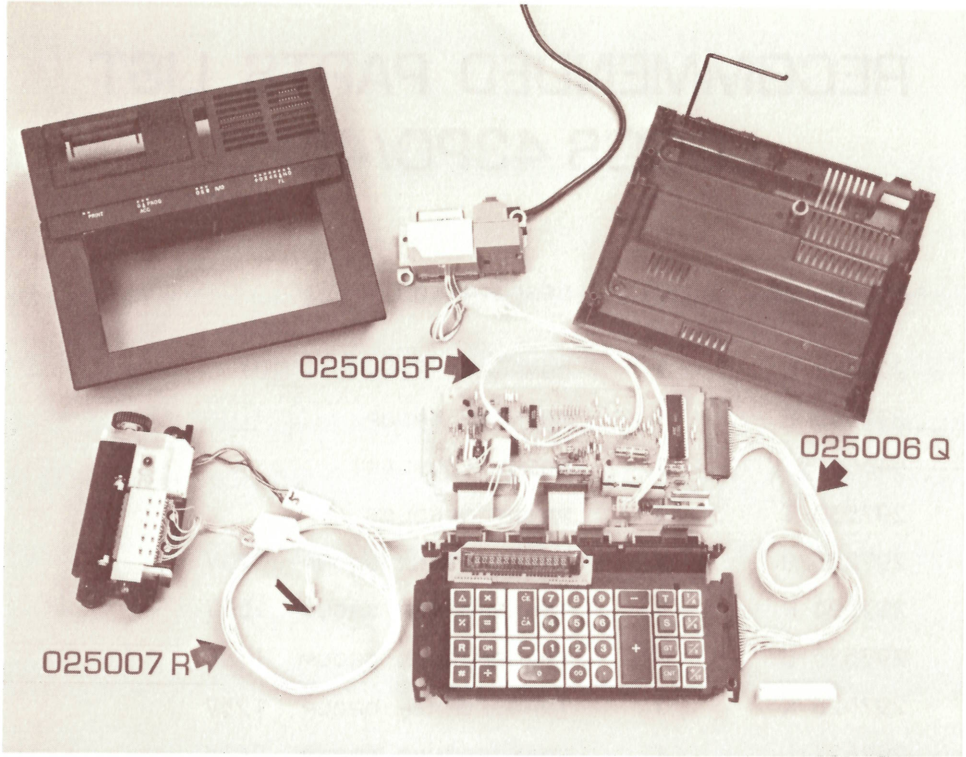


(EUR)

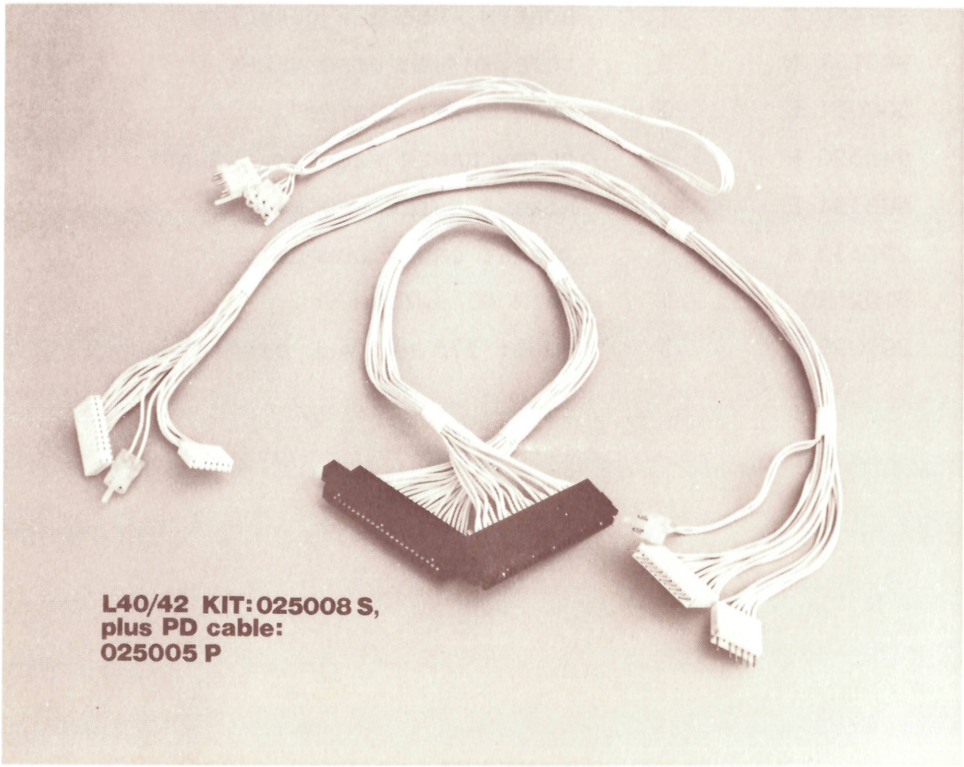


RECOMMENDED PARTS LIST
LOGOS 43PD/45PD

PART NUMBER	QTY	DESCRIPTION
298837 U	1	COMPLETE E.C.U. (NEC)
297305 E	1	PRINTER GROUP
5436995 C	1	MOTOR (BUHLER)
297530 T	4	PRINT NEEDLES
297523 Q	1	TRANSFORMER GROUP 220V
297524 R	1	TRANSFORMER GROUP 100V
297525 J	1	TRANSFORMER GROUP 115V
297526 K	1	TRANSFORMER GROUP 125V
297527 L	1	TRANSFORMER GROUP 240V
297498 V	1	BOARD-TO-BOARD CONNECTOR
297461 S	1	KEYSWITCH
297492 J	2	KEYTOP SPRING
298947 A	1	DISPLAY TUBE MOUNTED ON PC BOARD
297466 X	1	BOBBIN ASSEMBLY COMPLETE
945121 N	2	CLIP, STROBE DISC SHAFT
508051 E	2	GEAR SHAFT SPRING
945320 H	2	CLIP, PAPER FEED GEAR SHAFT
680334 E	1	NEEDLE GUIDE SPRING
297330 A	1	STROBE GROUP COMPLETE
5102180 A	1	MAIN AC SWITCH
297096 Q	3	FUSE: 375 mA; ALL DISPLAY MODELS



THIS PHOTO SHOWS THE EXTENSION CABLES INSTALLED ON THE DISASSEMBLED MACHINE, WHICH CAN BE OPERATED NORMALLY WHEN CONNECTED IN THIS MANNER. ALL CONNECTORS ARE KEYED FOR PROPER INSERTION.



A NEW CABLE HAS BEEN ADDED TO THE TECHNICIAN'S KIT: STAC CODE 025005 P CONNECTS THE TRANSFORMER MODULE (POWER SUPPLY) AND THE E.C.U. THE L40/42 CABLES (STAC CODE 025008 S) IS STILL REQUIRED FOR THE PRINTER AND E.C.U.

2L SECTION

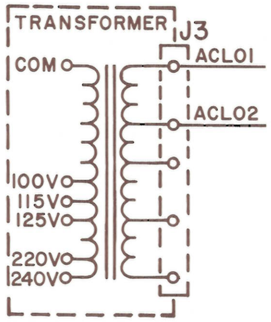
IN THIS SECTION THE TRANSFORMER, POWER SUPPLY AND MOTOR CIRCUITS WILL BE EXPLAINED IN DETAIL. READ THE PARAGRAPHS, IN ORDER, AND STUDY EACH OF THE ILLUSTRATIONS AS THE CIRCUITS ARE CONSTRUCTED. YOU SHOULD HAVE A GOOD WORKING KNOWLEDGE OF ALL DISCRETE CIRCUITRY UPON COMPLETION OF THIS SECTION.

KEEP IN MIND: ALL STATED VOLTAGES ARE NOMINAL AND MAY VARY.

VCF: +22 TO 40 VDC
VSS: +10 VDC ± 5%
VPR: +18 VDC ± 15%

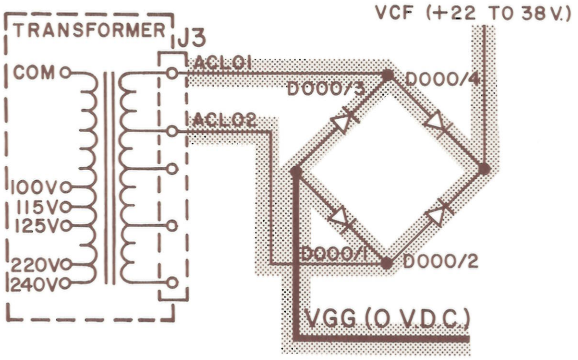
①

REGARDLESS OF THE LINE INPUT OF THE TRANSFORMER, THE OUTPUT SHOULD BE 22 TO 40 VOLTS AC AT CONNECTIONS ACLO1 AND ACLO2.



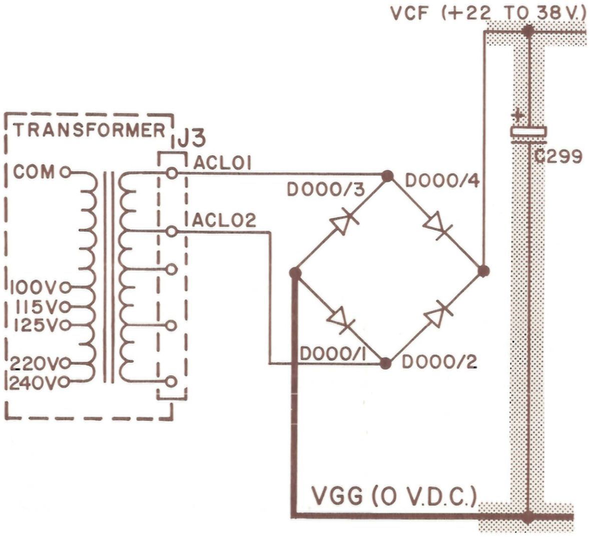
②

THIS AC VOLTAGE IS NOW RECTIFIED BY THE FOUR DIODES, YIELDING VCF (+38 VDC). THIS DC VOLTAGE IS PULSATING AND MUST BE "FILTERED" TO A CONSTANT DC VOLTAGE.



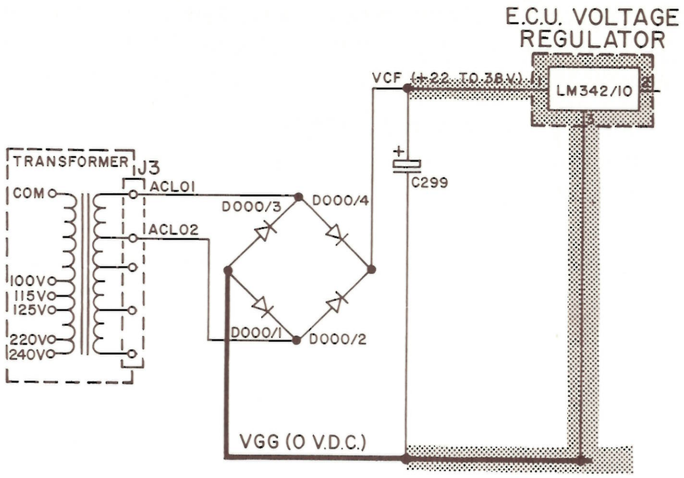
③

TO FILTER OR "LEVEL" THE PULSATION DC VOLTAGE, AN ELECTROLYTIC CAPACITOR (C299) IS PLACED IN THE CIRCUIT WHICH WILL ACCEPT THE PEAKS IN THE DC VOLTAGE BUT DISCHARGE AT A CONSTANT RATE, THUS FILTERING THE +38 VOLTS TO A CONSTANT LEVEL.



4

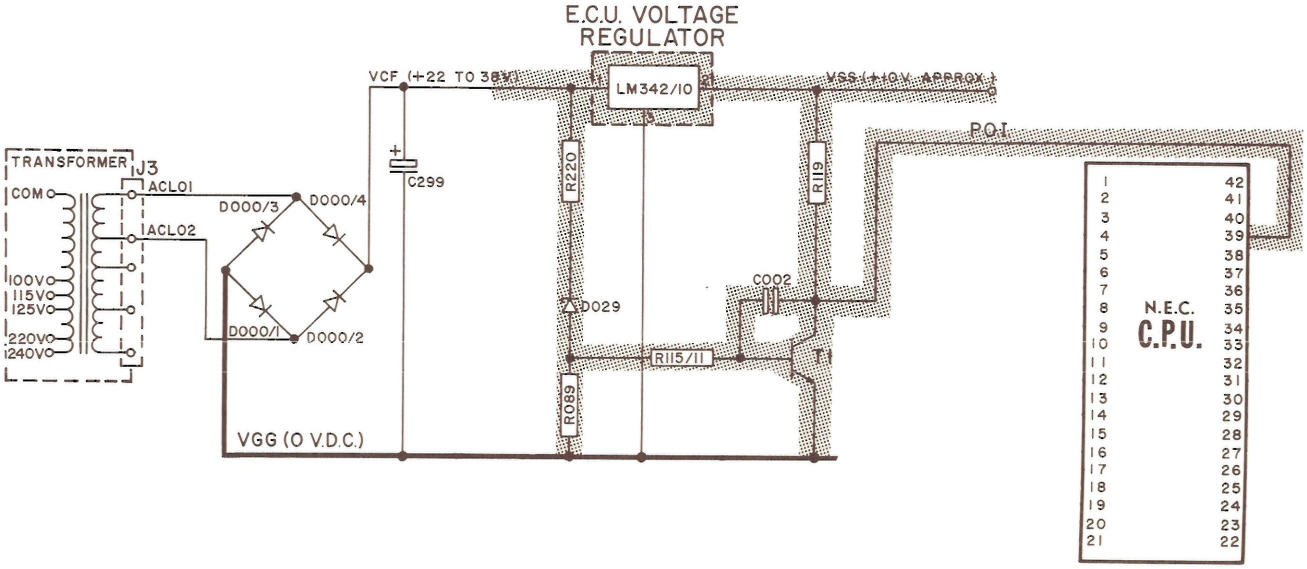
Before the voltage can be applied to the MOS device, it must be reduced to VSS: approximately +10 VDC. This is done by a monolithic voltage regulator LM342/10, which will have VCF as input (+38 VDC, pin 1), and an output of VSS (+10 VDC, pin 2). Pin 3 is VGG (system ground: zero Volts).

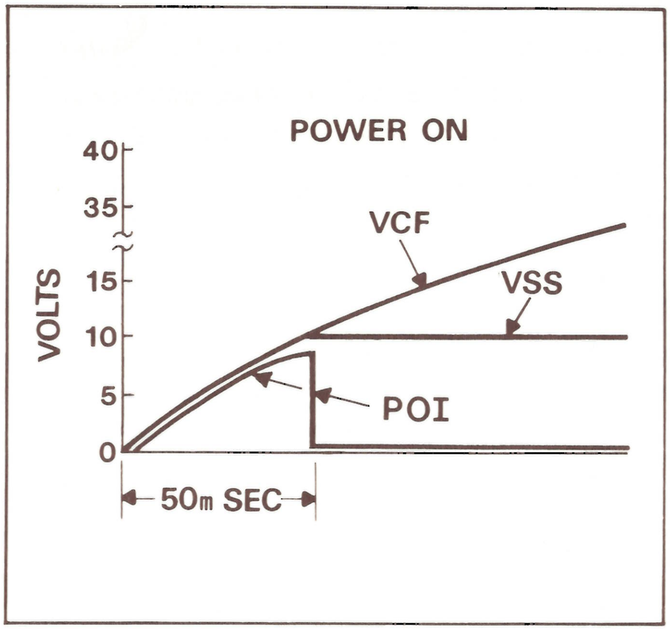


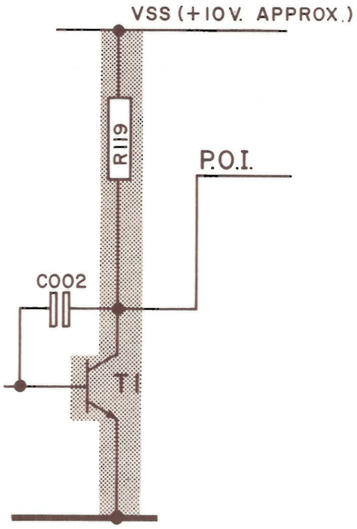
5

From the time at which correct voltage is applied to the MOS device, there is a 50 millisecond delay before printing, which is caused by the P.O.I. circuit.

As the voltage regulator LM342/10 receives VCF (+38 VDC), the reference point at P.O.I. will begin to rise. This current will be applied to the CPU at pin 39. Zener diode D029 will conduct voltage through resistors R089 and R220 to VGG, thus turning on the base-emitter junction of NPN transistor T1 through resistor R115/11. As T1 turns on, the voltage P.O.I. will be removed from the MOS device because it is switched to reference (VGG). This will zero and reset the CPU, and the machine will print zeroes as selected on the decimal switch, and "C" indicating Clear.



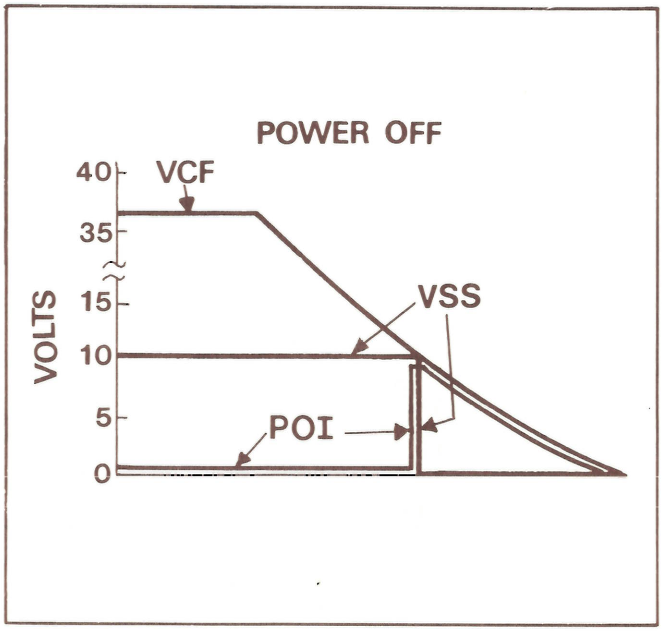




(Capacitor C002 prevents "ringing" of transistor T1.)

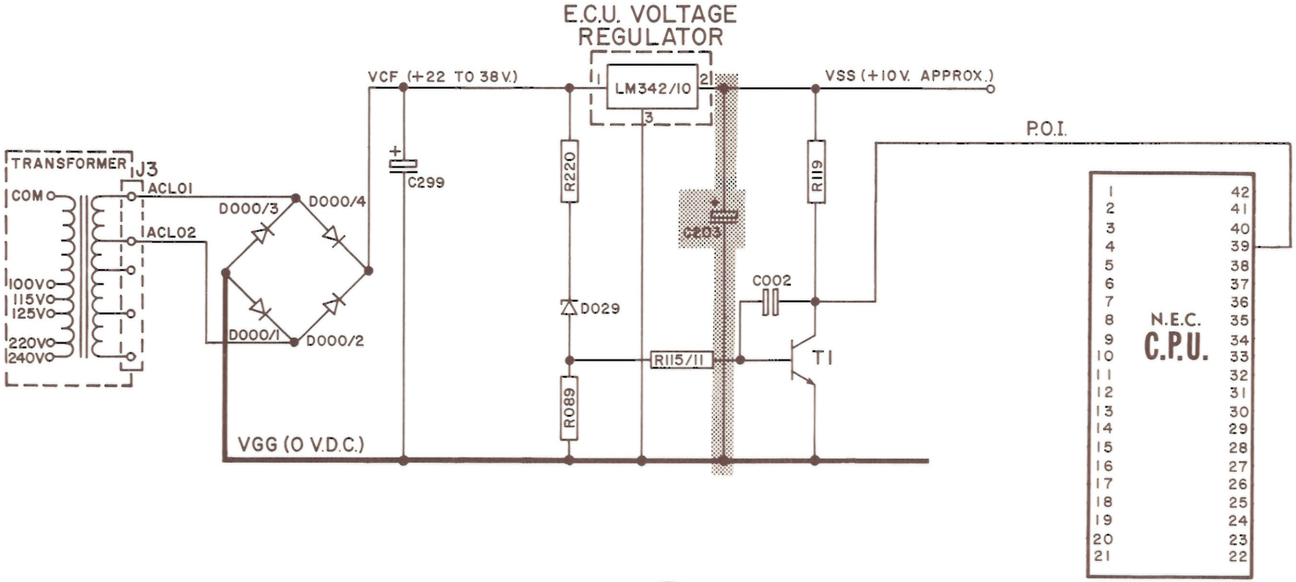
To fully understand the action of transistor T1 at the moment of Power-On Initialize, note the accompanying graphs. The first graph shows the voltage rise of VCF to +38 VDC when the machine is turned on. Notice: not until VCF reaches +10 VDC will transistor T1 turn on (delayed slightly by C000), removing P.O.I. from the MOS device and causing Power-On Initialize.

If VCF drops below +10 VDC for any reason (including machine shut-off) T1 immediately turns off, applying P.O.I. to pin 39, resetting the MOS. The second graph shows this application of P.O.I. upon a voltage drop in VCF.



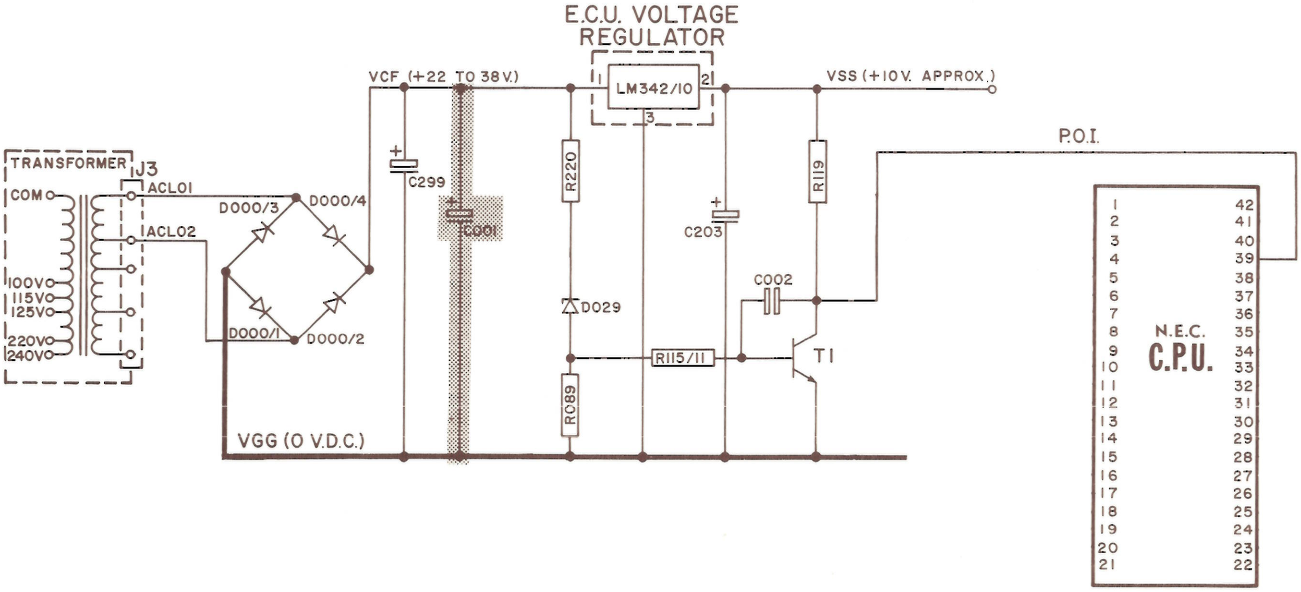
6

BECAUSE OF THE SWITCHING OF THE MOS DEVICE , THE LOADS ON THE OUTPUT OF THE POWER SUPPLY VARY DURING MACHINE OPERATION. THIS "NOISE" OR VARIANCE IN THE VOLTAGE COULD CAUSE PEAKS OR "SPIKES" IN THE VOLTAGE OF THE POWER SUPPLY, AND MALFUNCTION OF THE MOS DEVICE . A DECOUPLING CAPACITOR IS INSTALLED IN THE CIRCUIT TO ELIMINATE THE POSSIBILITY OF INTERFERENCE FROM HIGH FREQUENCY NOISE. THIS DECOUPLING CAPACITOR IS C203.



7

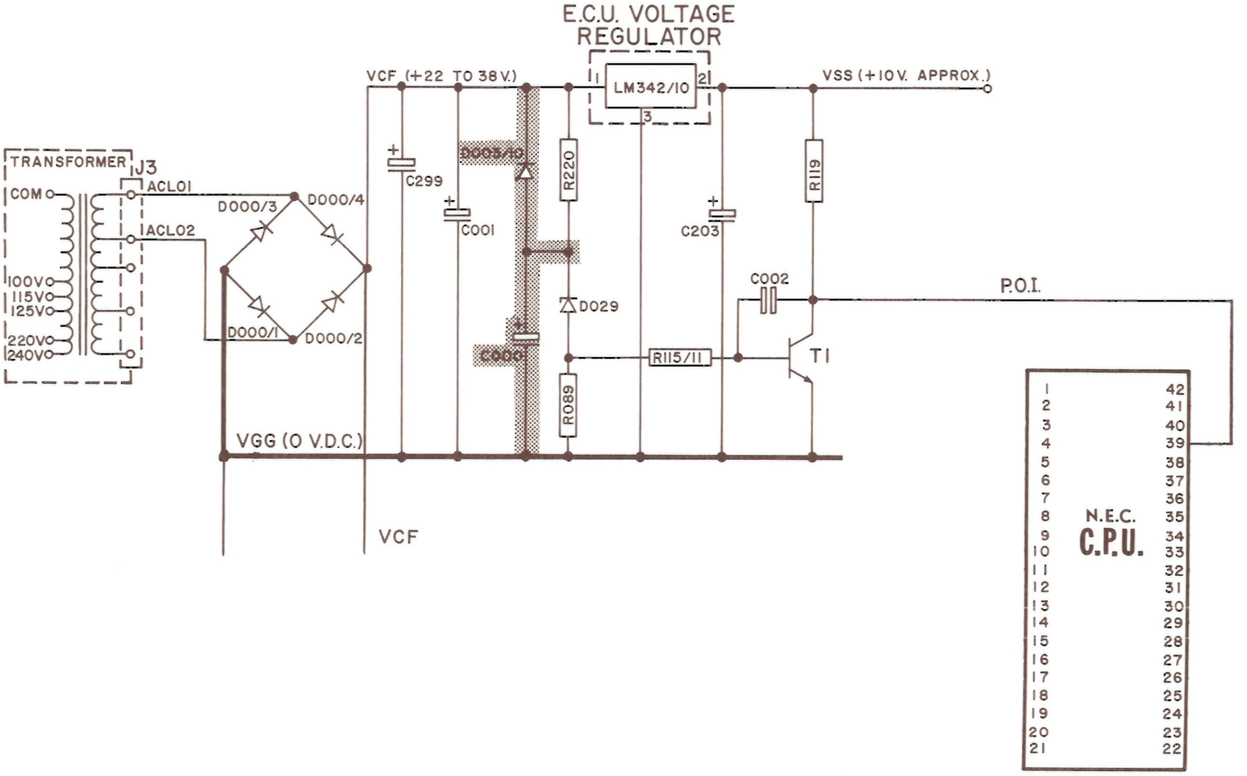
A BYPASS CAPACITOR (C001) HAS BEEN INCLUDED TO ELIMINATE "FEEDBACK" OR OSCILLATION OF THE VOLTAGE REGULATOR LM342/10. ALSO, RADIOS AND OTHER RF DEVICES MAY BE AFFECTED IF THIS CAPACITOR WERE NOT PRESENT.

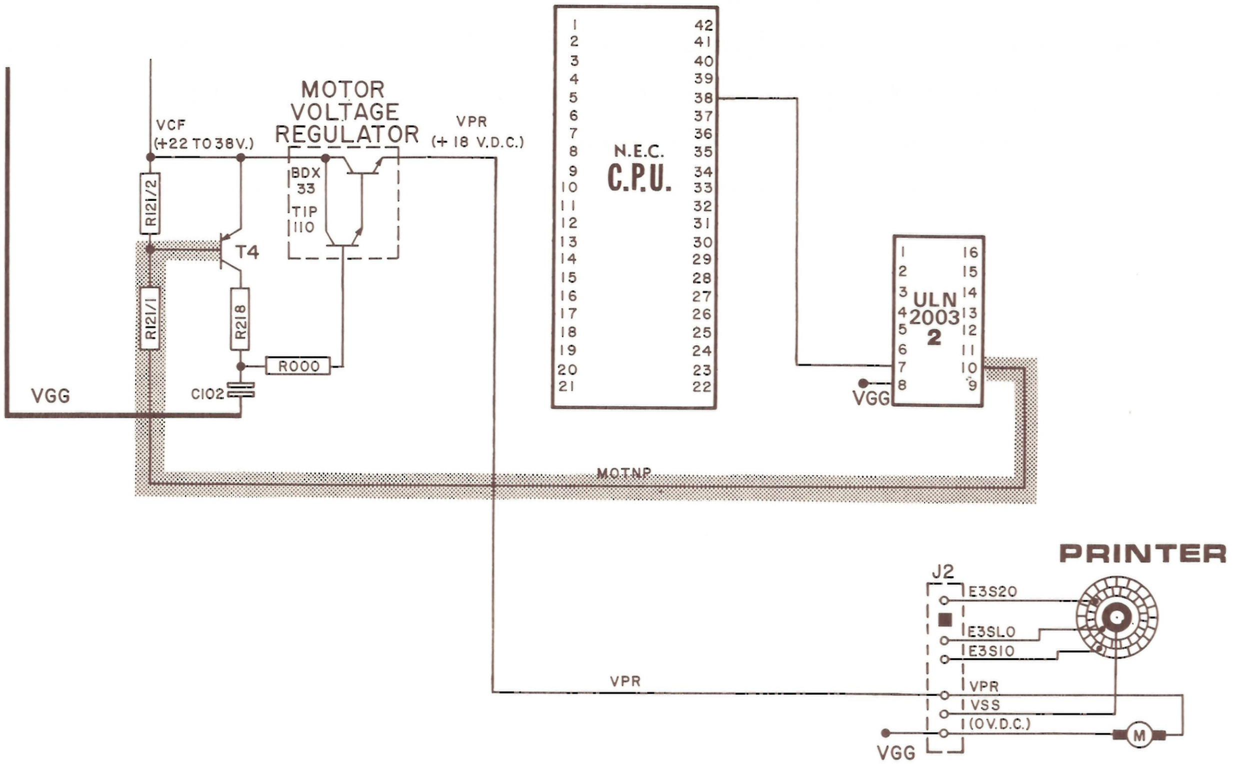


A protection circuit has been incorporated so that the power to the MOS device will be shut off if VCF becomes too low in voltage. If this condition were not checked, and the power supply voltage dropped below the minimum, the MOS device could not retain correct information, or operate properly, and the operator would get erroneous information.

If VCF drops too low, capacitor C000 will discharge through diode D003/10 to the load of the MOS. This will pull the voltage from Zener diode D029, thus removing the voltage from transistor T1 and turning it off. T1 turns off, and allows the voltage to be present at point P.O.I. When VCF again rises, capacitor C000 will charge up through resistor R220. At the same time, the Zener diode D029 will now conduct and apply voltage to the base-emitter junction of T1, switching P.O.I. to VGG: 0 VDC. It is true that all totals are lost, but the machine will function properly because of clearing and zeroing at the time of power return.

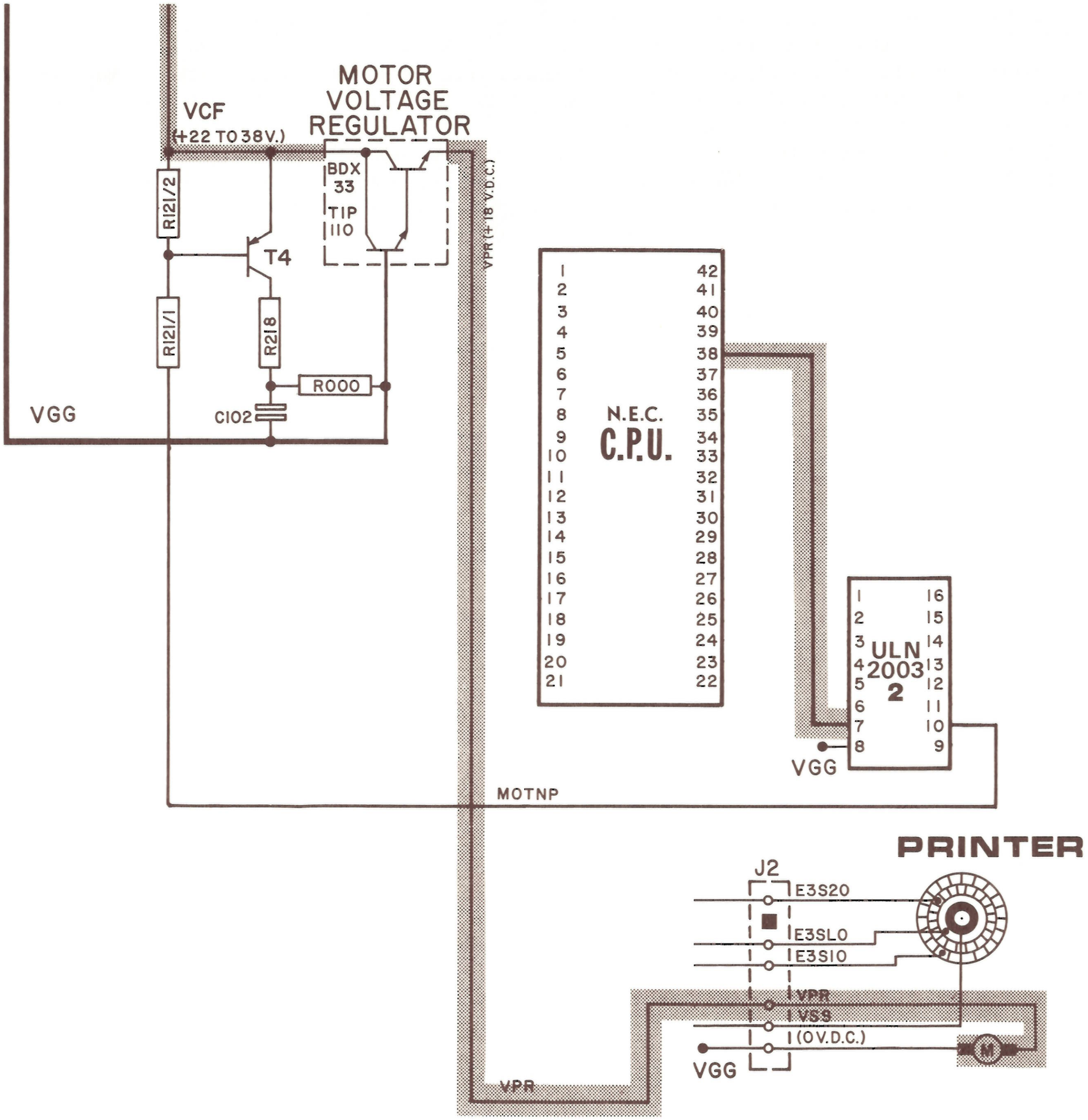
Please note that from the power supply there are two lines: VGG (zero VDC) and VCF (+38 VDC). VCF will be used to run the printer, after it has been regulated to a voltage which will be discussed next.





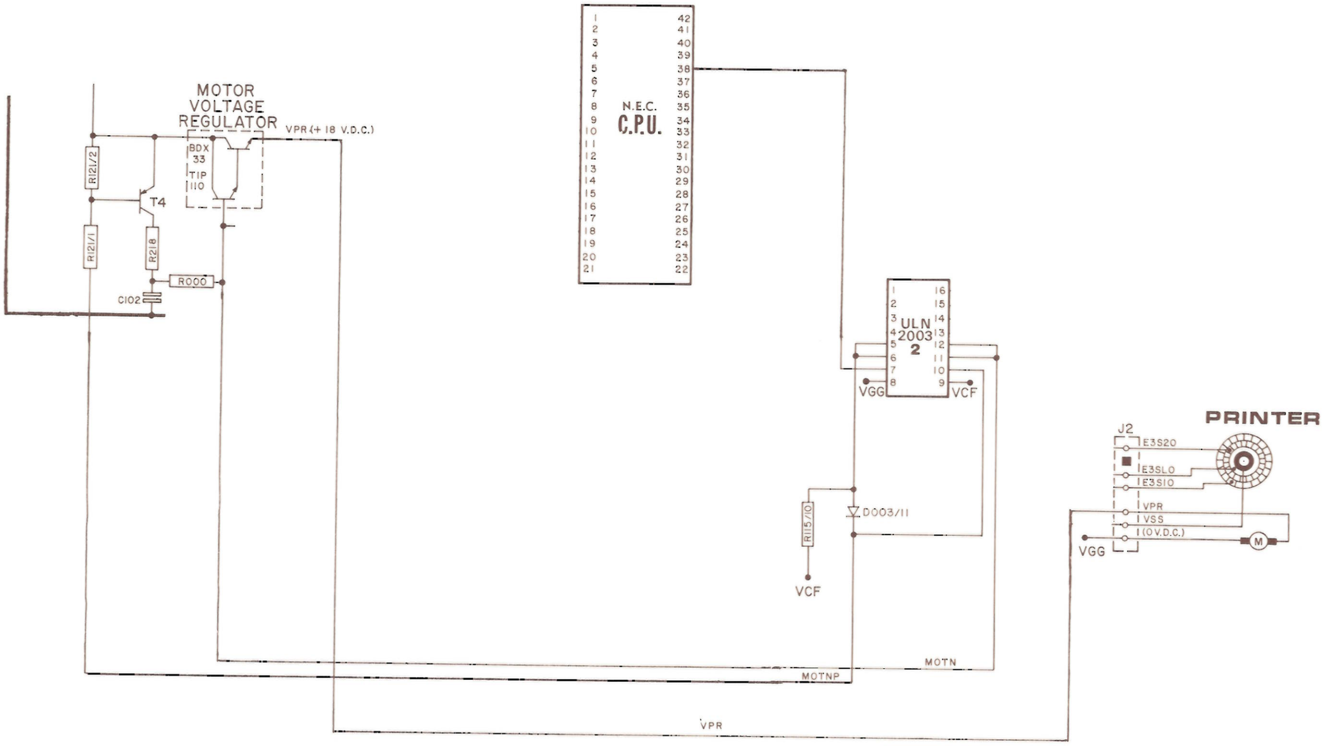
As indicated in the motor circuit diagram, VCF (+38 VDC) will enter the motor voltage regulator and exit as VPR (+18 VDC). The regulation will be discussed later as will the operation of the IC drivers. A signal from the CPU MOS device (pin 38, Print On-Off) starts and stops the printer motor by means of the IC driver ULN2003/2. The reason for using the IC drivers is that they can control a greater current than can the MOS devices.

With the machine on and the printer not running, the motor circuit is off because transistor T4 is not allowing the motor voltage regulator BDX33 to turn on. This is done by applying 0 VDC from the CPU MOS device (pin 38, Print On-Off), causing a high-gain Darlington switch to remain off. The result is that VCF (+38 VDC) remains at the base of T4. T4 is off, preventing the motor voltage regulator from producing VPR (+18 VDC) because its base-emitter junction is turned off. At the same time the collector is at VCF (+38 VDC). With the motor at rest, it is important to keep in mind that the signal MOTNP is at +38 VDC.



When the machine is required to print, the CPU MOS device must turn on the motor. Pin 38 of the CPU (Print On-Off) switches high (to VSS). When this happens, the IC driver will switch MOTNP to VGG (0 VDC). This will present 0 VDC to the base bias network of PNP transistor T4. Current will now flow through T4, allowing the motor voltage regulator BDX33 to turn on, and produce VPR (+18 VDC) to run the printer motor.

To further clarify the motor circuit, printer On and Off, when pin 38 on the CPU is low (0 VDC), the IC driver pin 10 will be at VCF: +38 VDC. In this condition, the motor is off because T4 is off. If pin 10 on the IC driver (MOTNP) is at VCF (+38 VDC), pins 5 and 6 on the IC driver will also be high because VCF will conduct through diode D003/11. If pins 5 and 6 are high, the Darlington array in the IC driver will switch on; this will reference the output pins 11 and 12 (MOTN) to VGG (0 VDC).
When pin 38 on the CPU is high (+10 VDC) it will switch the Darlington array (pin 10) to reference (0 VDC), which will turn on transistor T4 and start the motor, as described. At the same time, through diode D003/11, input pins 5 and 6 will also be at reference (0 VDC). In this case, the Darlington arrays from pins 5 and 6 will be switched off. In this condition pins 11 and 12 will be high, allowing current to be present from the base of the motor voltage regulator. As a result, motor Start and Stop, and braking, can be controlled by using one pin (pin 38) from the CPU MOS device.



Four sections were omitted from the motor circuit as described to this point:

A, a circuit to control the voltage regulator. Uncontrolled, the Darlington array in the regulator would cause a continuous increase in voltage (VPR) to the motor, instead of a stable +18 VDC;

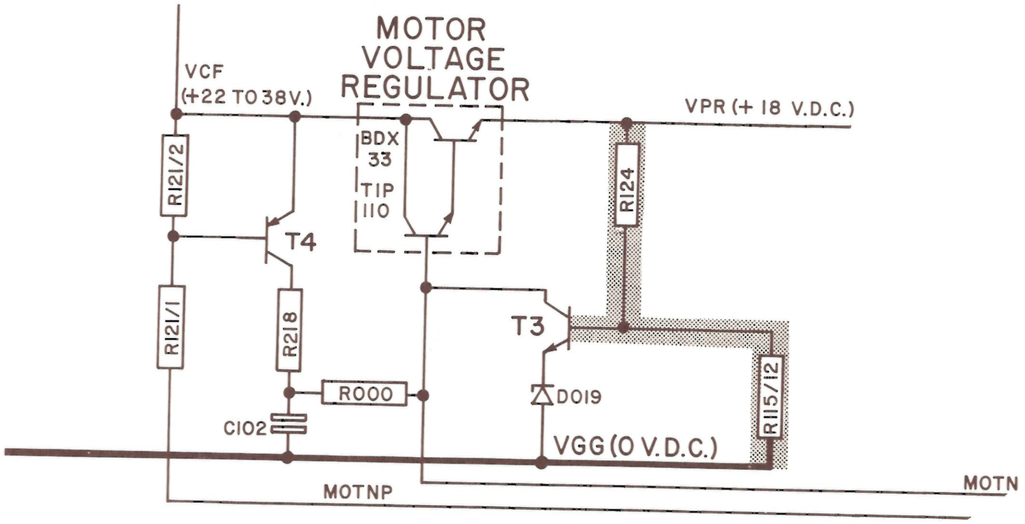
B, a provision for external adjustment of printer motor speed. This is done because of the variance of motor voltage required in different printers. Optimum print quality is achieved at uniform printer speeds;

C, a circuit to allow VPR (+18 VDC) to attain its operating voltage and to maintain this voltage at a consistent level, regardless of variations in load;

D, dynamic braking of the printer motor to prevent coasting, which could cause the printer to run past the proper E3SL0/E3S10 starting point. This would cause the printer to cycle to the next starting point before printing could begin. This circuit also helps suppress RFI (noise) generated by the printer motor.

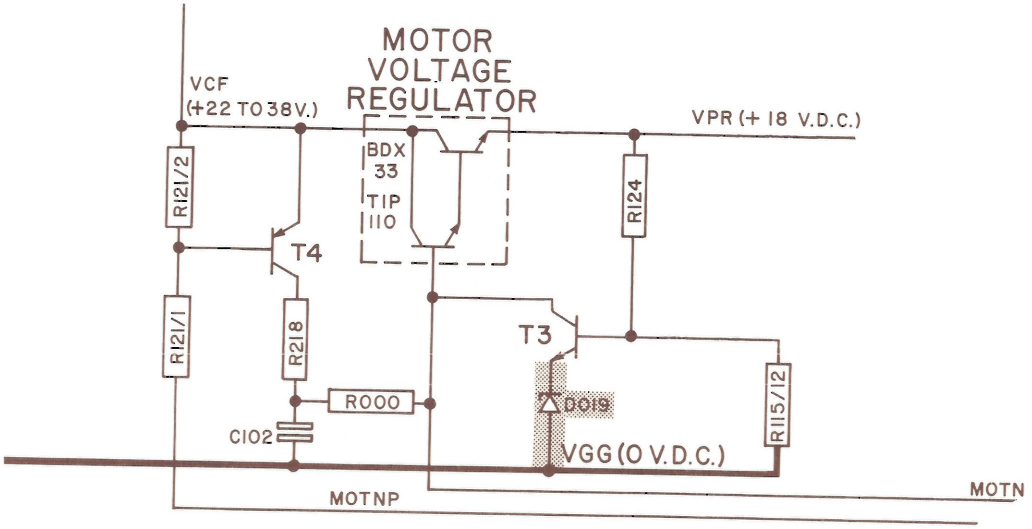
12

VPR MUST BE CONTROLLED TO PREVENT IT FROM RISING ABOVE +18 VDC WHEN THE MOTOR IS RUNNING. THIS IS DONE BY NPN TRANSISTOR T3 THROUGH THE BIASING NETWORK AS SHOWN BELOW. T3 ESTABLISHES THE BASE CURRENT OF THE MOTOR VOLTAGE REGULATOR.



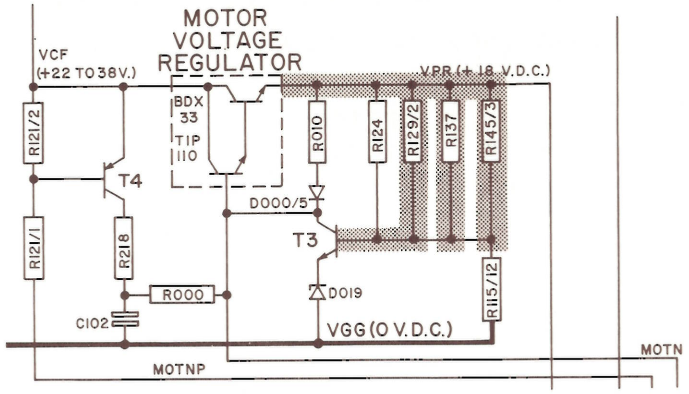
13

A ZENER DIODE (D019) IN THE REGULATION CIRCUIT ESTABLISHES THE REFERENCE FOR THE MOTOR VOLTAGE REGULATOR BDX33. THE ZENER DIODE WILL NOT CONDUCT UNTIL AN OPERATING VOLTAGE OF +6 VDC HAS BEEN REACHED BY THE BASE-EMITTER JUNCTION OF TRANSISTOR T3. THIS ENSURES THAT VPR (+18 VDC) IS MAINTAINED AT THE CORRECT OPERATING VOLTAGE RANGE.



14

EXTERNAL ADJUSTMENT OF THE VOLTAGE TO THE PRINTER HAS BEEN MADE POSSIBLE BY INCLUDING THREE RESISTORS (R129/2, R137, AND R145/3) PLACED IN PARALLEL IN THE CIRCUIT WHICH CONTROLS THE PUTPUT OF VPR (+18 VDC). BY REMOVING FROM THE CIRCUIT ANY COMBINATION OF THESE RESISTORS (THUS CHANGING THE VOLTAGE), THE TECHNICIAN CAN OBTAIN THE PROPER PRINT SPEED TO MAINTAIN OPTIMUM PRINTING QUALITY.

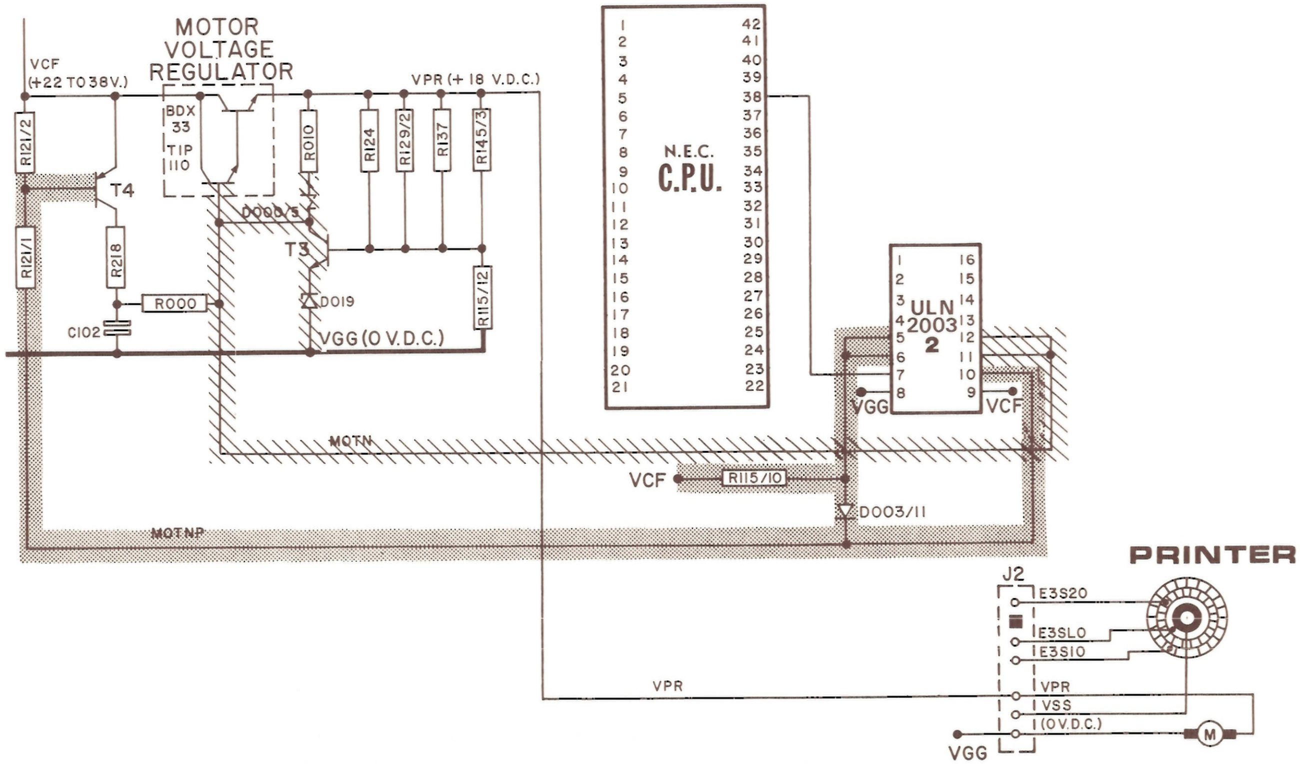


15

AS PREVIOUSLY MENTIONED, A CIRCUIT IS INCLUDED THAT WILL DYNAMICALLY BRAKE OR STOP THE MOTOR TO PREVENT ITS COASTING PAST THE PROPER STARTING POINT. TO DO THIS, TWO THINGS MUST BE DONE: THE MOTOR CIRCUIT MUST BE TURNED OFF; AND THE REGENERATIVE MOTOR CURRENT (DUE TO COASTING) MUST BE ELIMINATED.

WHEN MOTNP HAS BEEN SWITCHED TO +38 VDC (CAUSING TRANSISTOR T4 TO TURN OFF), THE MOTOR VOLTAGE REGULATOR WILL ALSO TURN OFF; HOWEVER:

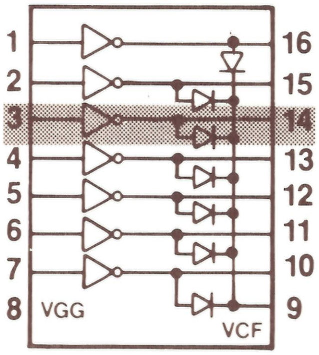
REGENERATIVE VOLTAGE IN THE MOTOR CIRCUIT MUST BE ELIMINATED. THIS IS DONE BY DIODE D000/5, WHICH PULLS VPR (+18 VDC) TO REFERENCE ZERO (VGG, VIA MOTN) AND ADDS A HIGH LOAD TO THE MOTOR. THIS LOAD FUNCTION IMMEDIATELY CAUSES THE MOTOR TO STOP. RESISTOR R010 IS THE CURRENT-LIMITING DEVICE FOR THE PROTECTION OF THE IC DRIVER.



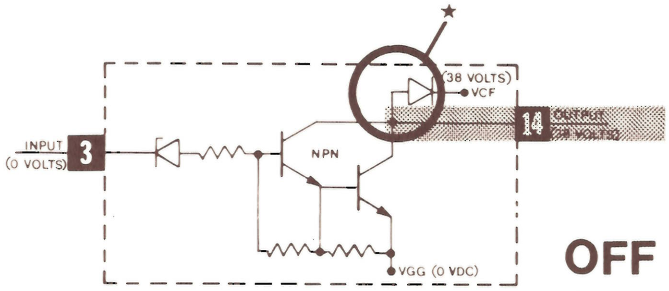
THIS PART OF THE DISCUSSION IS ON THE OPERATION OF THE IC DRIVERS, ULN2003/1 AND ULN2003/2, IN CONJUNCTION WITH THE CPU MOS DEVICE.

THE IC DRIVERS ARE SIMPLY A LOW VOLTAGE SWITCHING DEVICE TO CONTROL HIGH VOLTAGE OUTPUT. WITH THIS IN MIND, CONSIDER ONE SEGMENT OF ONE OF THE DRIVERS. IF THE INPUT SIGNAL FROM A SOURCE ON PIN 3 IS 0 VDC, THE DARLINGTON ARRAY CANNOT TURN ON, AND PIN 14 WOULD BE AT ITS RESPECTIVE SUPPLY VOLTAGE.

LOGIC DIAGRAM

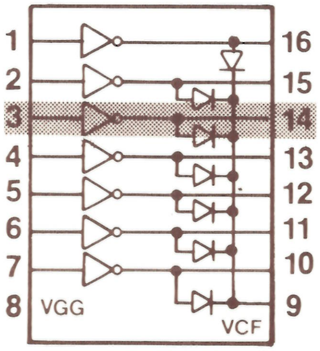


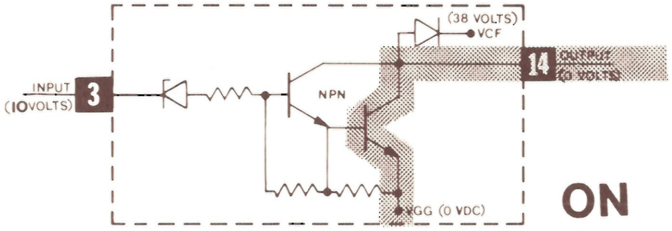
SCHEMATIC DIAGRAM



★ THIS DIODE LIMITS "INDUCTIVE KICKBACK" TO +38 VDC WHEN A BOBBIN IS DE-ENERGIZED.

IF THE INPUT SIGNAL (PIN 3) IS SEVEN TO EIGHTEEN VOLTS, THE DARLINGTON ARRAY WOULD TURN ON, AND PIN 14 WOULD BE AT 0 VDC. THE RESPECTIVE SUPPLY VOLTAGE WOULD BE PULLED TO GROUND (VGG).

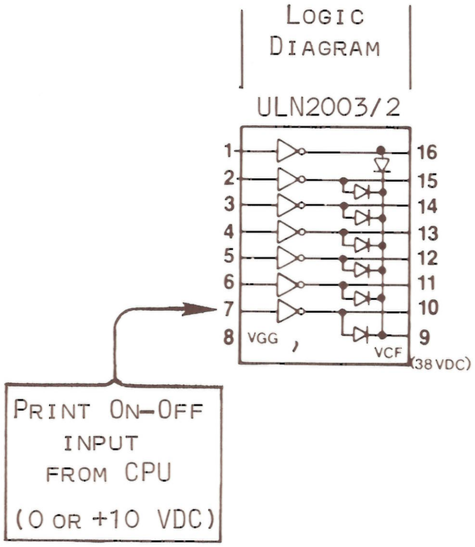


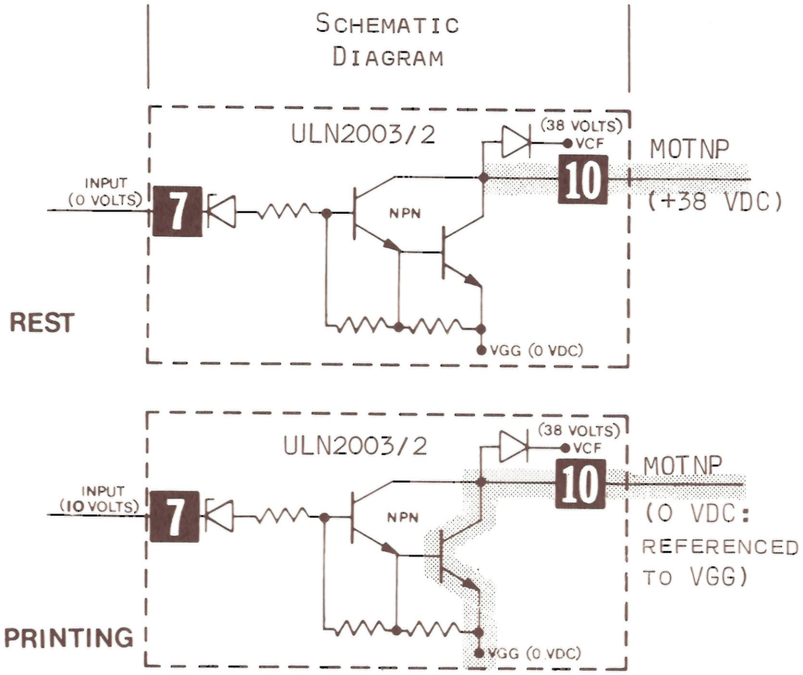


17

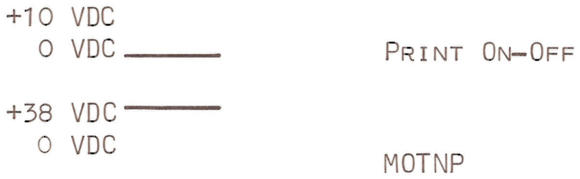
To fully understand the operation of the IC drivers in relation to the CPU, follow the explanation and diagrams that follow:

Assume that the machine is on and the printer at rest. Pin 7 of ULN2003/2 (the signal for Print On-Off from CPU pin 38) is at 0 VDC (VGG). The Darlington switch is off, so MOTNP (pin 10) is NOT referenced to VGG: it is at +38 VDC, therefore transistor T4 is off, and the motor voltage regulator is off.

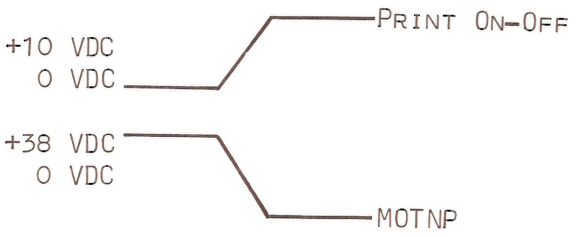




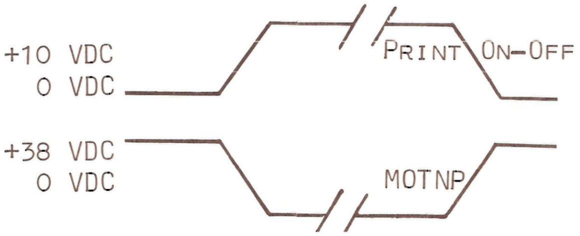
With the machine on and the printer at rest, pin 38 (Print On-Off) is at 0 VDC, and MOTNP (to T4) will be at +38 VDC:



When the machine is required to print, pin 38 switches high (to VSS), and the Darlington switch of the IC driver will connect MOTNP to VGG -- causing T4 to turn on the motor voltage regulator (review items 9 and 10):



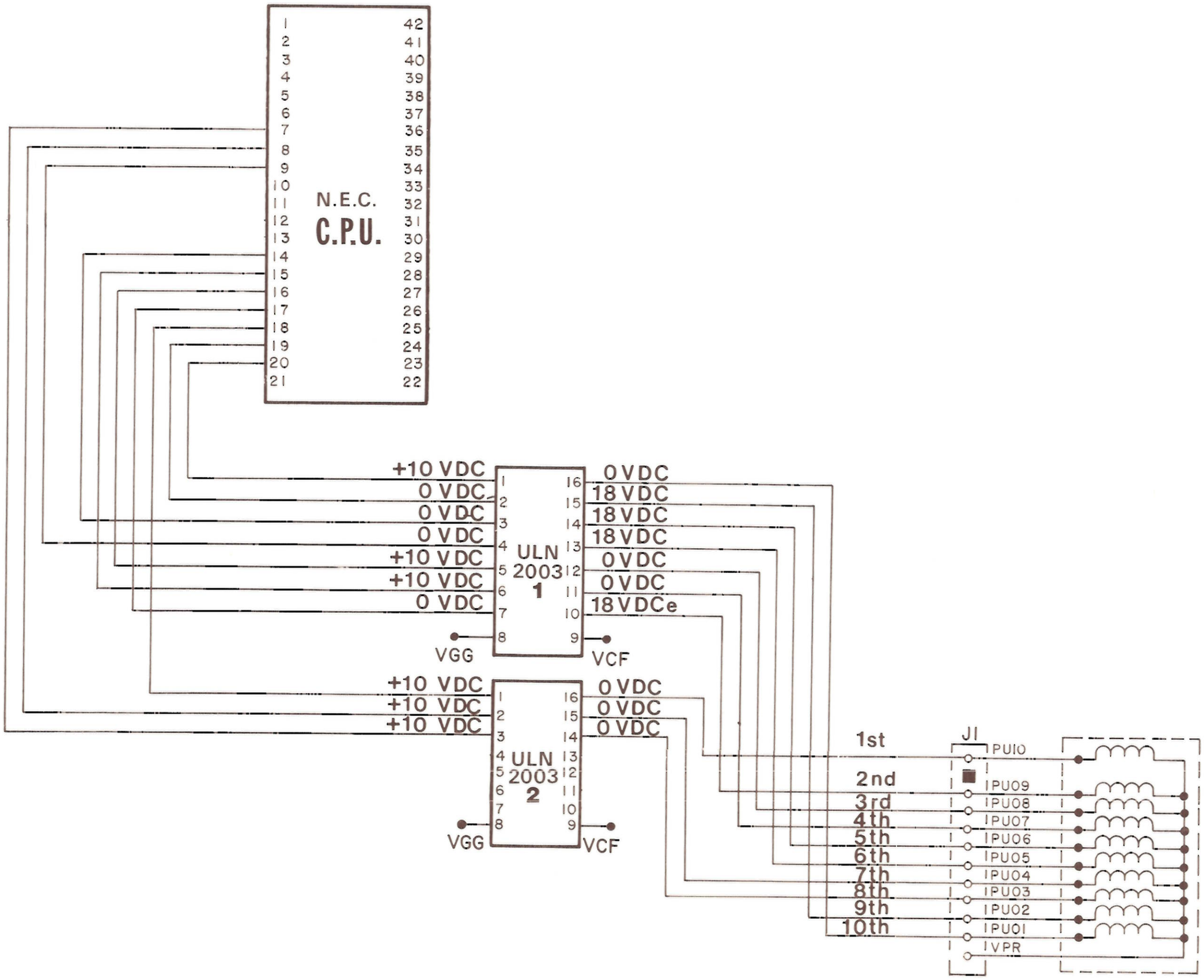
At the completion of the print cycle, pin 38 returns to 0 VDC, the IC driver switches off (causing MOTNP to return to +38 VDC), and T4 turns off the motor voltage regulator:



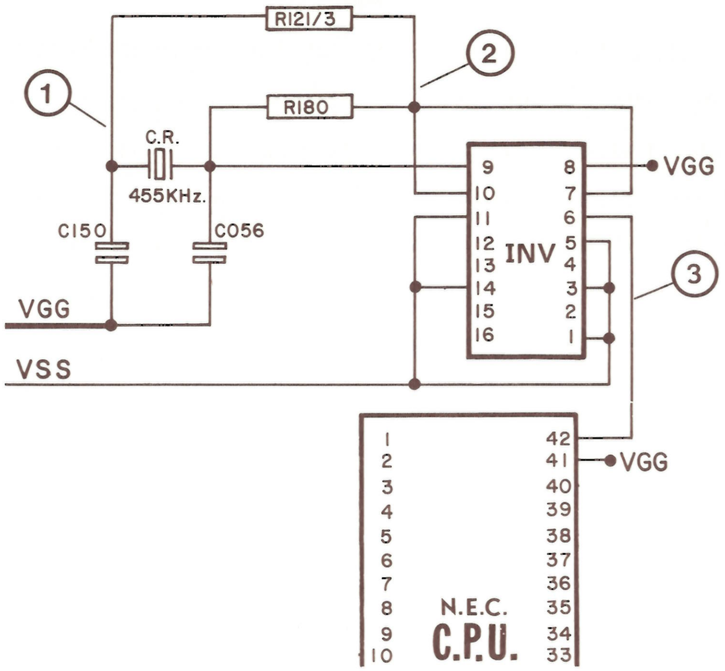
18

Once the motor circuit has turned on and the printer starts to run, the strobe disc generates dot-print signals which inform the CPU that the printer is requesting input. The CPU MOS device will output to the IC drivers either VGG or VSS: 0 or +10 VDC. As previously explained, an input of 0 Volts to the drivers will prevent them from switching to ground any signal applied to their "output" side. Conversely, an input of +10 Volts to the drivers will cause them to switch their "output" side to ground. In the case of the bobbins (pins 1 through 7 and 10 through 16 of ULN2003/1, and pins 1 through 3 and 14 through 16 of ULN2003/2), it is VPR that is either allowed to reach ground or prevented from reaching ground, as follows:

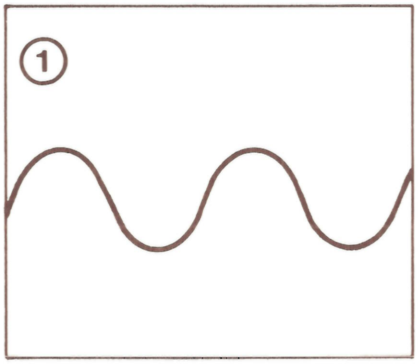
VPR is applied to one side of all bobbins. When the other side of a bobbin is sent to ground (VGG) by the drivers, that bobbin is energized, and will interrupt the magnetic field holding the anchor and print needle: a dot will print. In the example below, printed dots will result from energizing the first, third, fourth, seventh, eighth and tenth bobbins.



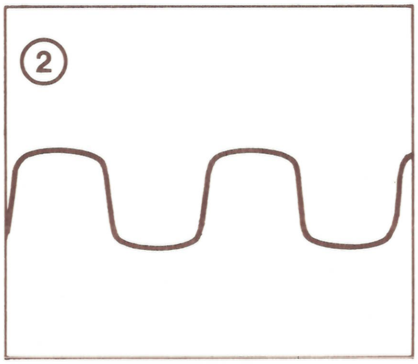
19



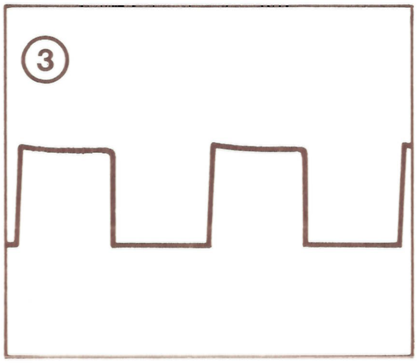
THE TIMING DEVICE FOR THE CALCULATOR IS A CLOCK CIRCUIT WHICH INCLUDES A CERAMIC RESONATOR AND CMOS INVERTER, IN ADDITION TO SEVERAL DISCRETE COMPONENTS. THE RESONATOR AND ONE SEGMENT OF THE INVERTER (WITH ASSOCIATED BIAS COMPONENTS) FORM AN OSCILLATOR, WITH THE RESONATOR PROVIDING FEEDBACK AT THE SPECIFIED FREQUENCY OF 455 KHZ. CAPACITORS C150 AND C056 ACT AS HIGH-FREQUENCY SHUNTS, TO PREVENT OPERATION AT OTHER THAN SPECIFIED FREQUENCY. A SINEWAVE CAN BE OBSERVED USING AN OSCILLOSCOPE AT ① ABOVE. IF OBSERVED AT POINT ②, IT WOULD RESEMBLE THE SECOND WAVEFORM BELOW: NEARLY A SQUARE-WAVE. THIS SIGNAL IS FED TO ONE MORE SEGMENT OF THE INVERTER, WHICH WILL "SQUARE" THE WAVE FURTHER, SO THAT THE FINAL CLOCK SIGNAL SENT TO PIN 42 OF THE CPU LOOKS LIKE ③ :



WAVEFORM AT RESONATOR

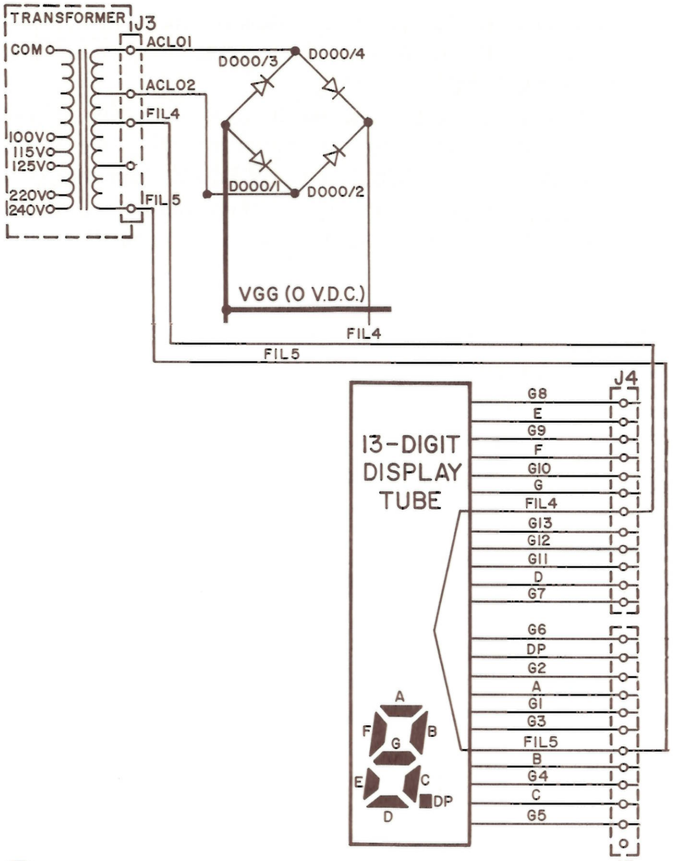


INTERMEDIATE WAVEFORM



FINAL CLOCK SIGNAL

20

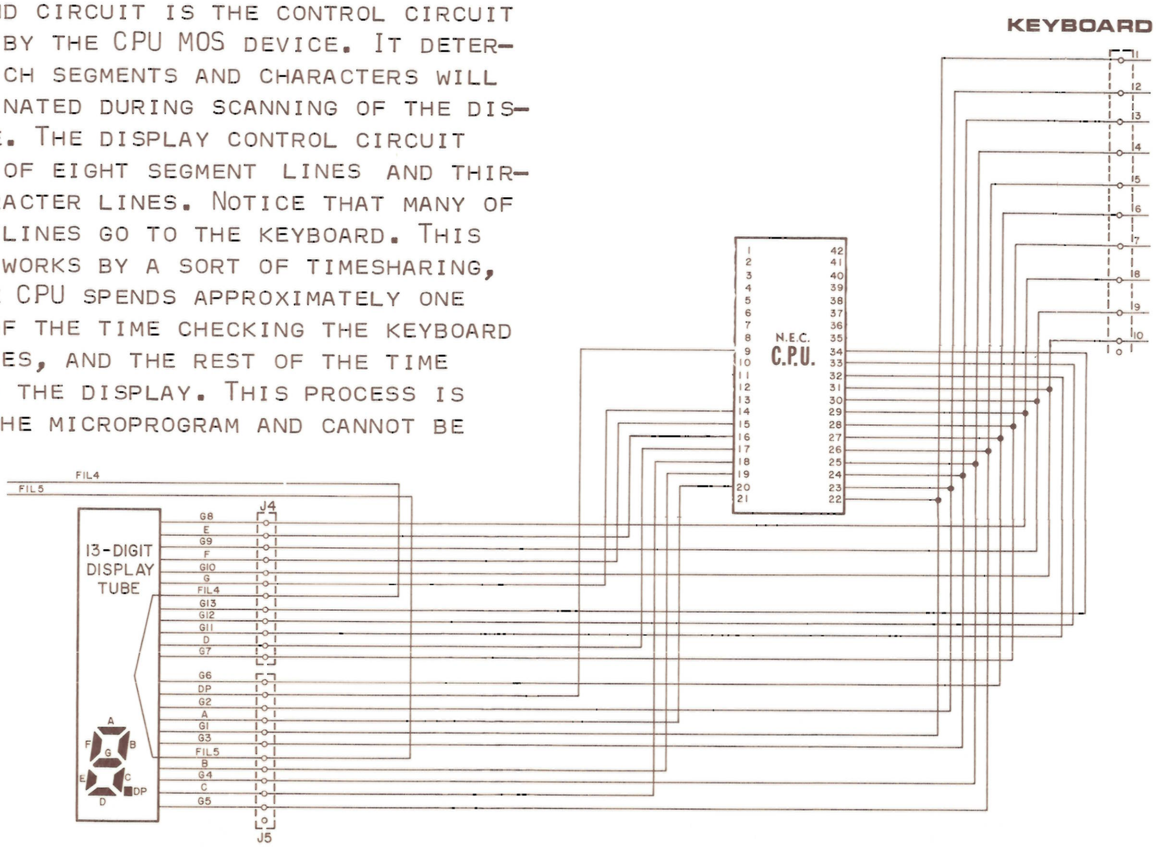


AS DISCUSSED ON PAGES 24 AND 25, THE CALCULATOR HAS A VACUUM DISPLAY TUBE. TO OPERATE THIS DISPLAY, FOUR SPECIAL CIRCUITS ARE REQUIRED.

THE FIRST IS SIMPLY A 3.8 VOLT AC SUPPLY FOR THE FILAMENT, DIRECT FROM THE TRANSFORMER SECONDARY VIA FIL4 AND FIL5.

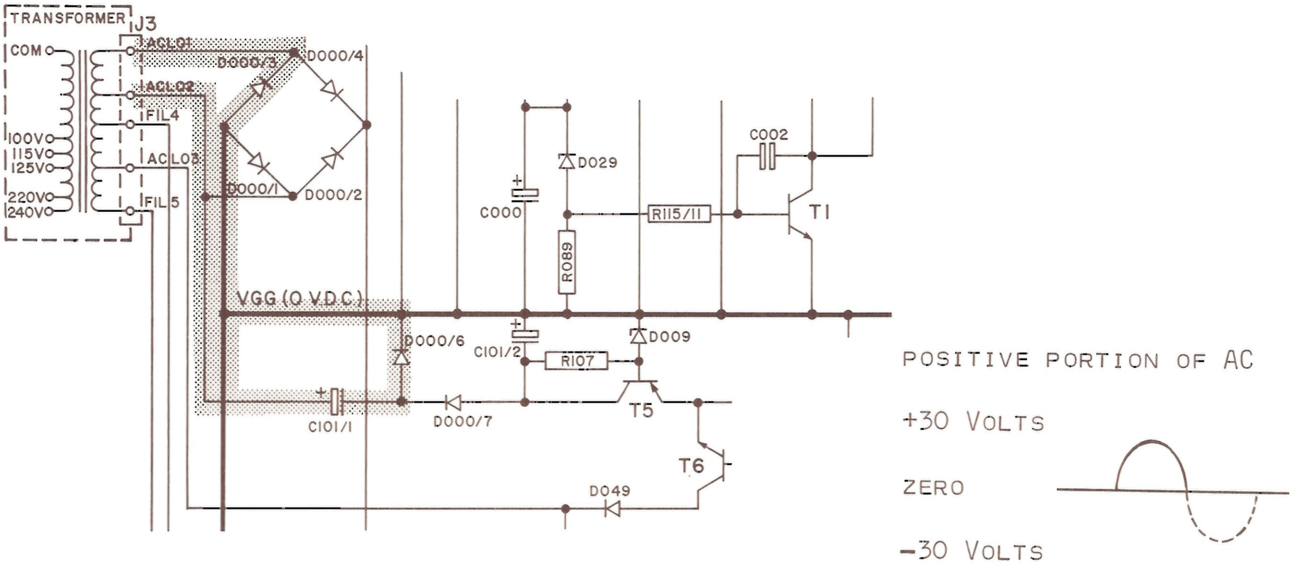
21

THE SECOND CIRCUIT IS THE CONTROL CIRCUIT PROVIDED BY THE CPU MOS DEVICE. IT DETERMINES WHICH SEGMENTS AND CHARACTERS WILL BE ILLUMINATED DURING SCANNING OF THE DISPLAY TUBE. THE DISPLAY CONTROL CIRCUIT CONSISTS OF EIGHT SEGMENT LINES AND THIRTEEN CHARACTER LINES. NOTICE THAT MANY OF THE SAME LINES GO TO THE KEYBOARD. THIS PRACTICE WORKS BY A SORT OF TIMESHARING, WHERE THE CPU SPENDS APPROXIMATELY ONE QUARTER OF THE TIME CHECKING THE KEYBOARD FOR ENTRIES, AND THE REST OF THE TIME OPERATING THE DISPLAY. THIS PROCESS IS PART OF THE MICROPROGRAM AND CANNOT BE OBSERVED.

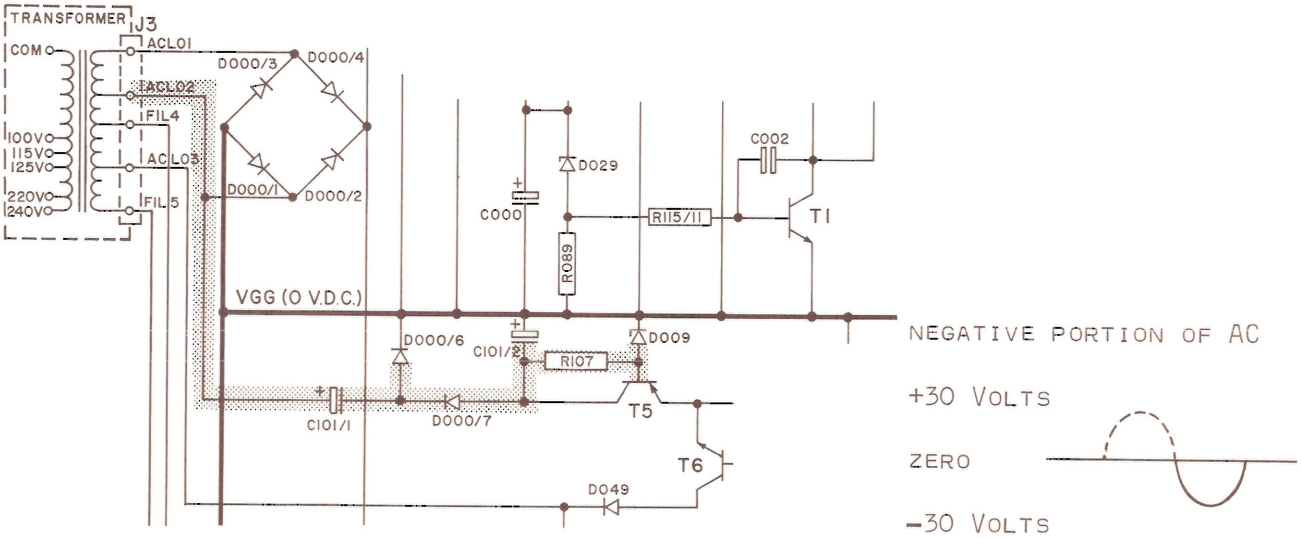


The third circuit is for a negative reference voltage which is required to light the tube as previously described. This negative voltage is VDISP, and is -20.0 VDC.

The first step in producing VDISP is half-wave rectification, using primarily the negative portion of AC, by electrolytic capacitors C101/1 and C101/2, and diodes D000/6 and D000/7, as well as D000/3. As shown in the figure below, during the positive wave, current flows as indicated through diodes D000/3 and D000/6 to charge electrolytic capacitor C101/1:



During the negative wave of AC, current flows as follows: through diode D000/7, thus charging capacitor C101/2 (voltage leveling) and through resistor R107 to the base of transistor T5. Remember that this is during the negative wave. Capacitor C101/1 will discharge, in effect charging C101/2 and at the same time producing a negative voltage at T5 (in reference to VGG). The negative voltage at the anode of the Zener diode D009 would be approximately -35 VDC, but because of the voltage drop across the Zener diode, and the voltage regulation of T5 with reference to the Zener, the resulting voltage (VDISP) is approximately -20.0 VDC.

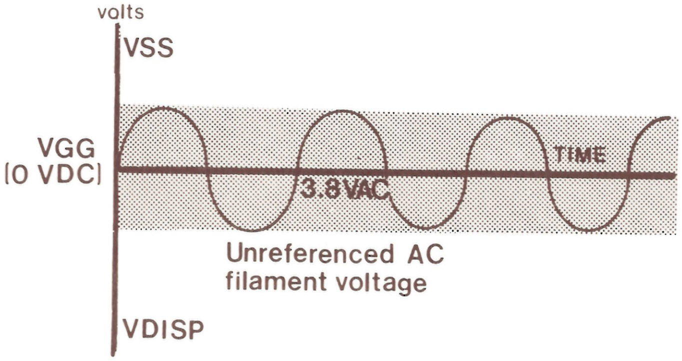


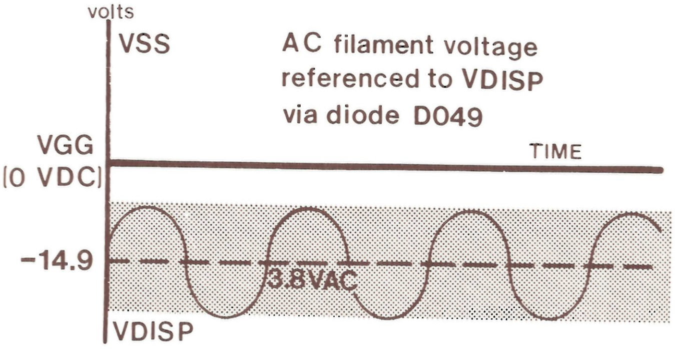
23

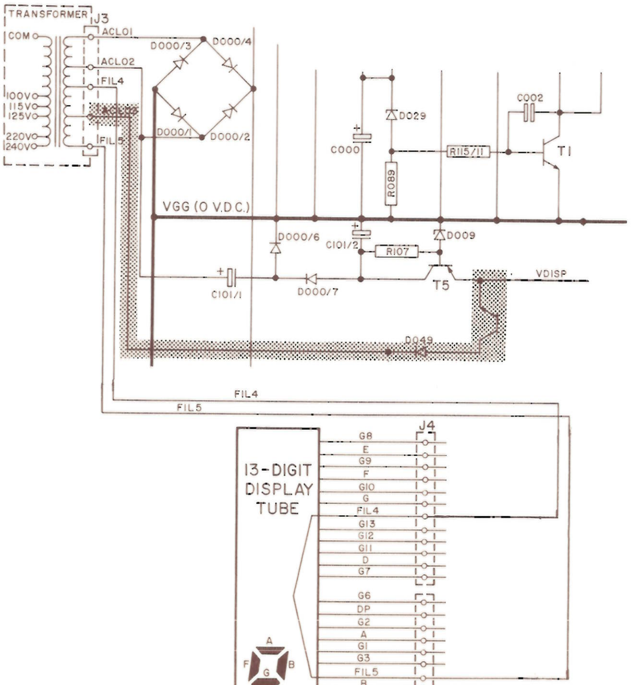
To this point we have introduced an AC voltage to the filament: FIL4 and FIL5. By introducing a center-tap between FIL4 and FIL5, and then connecting this center-tap to a negative voltage source, the AC voltage is shifted negative and, at the same time, referenced to the controlled voltages of the machine.

The connection to VDISP is through a 5.1 Volt Zener diode, so the negative shift is 20.0 (VDISP), less 5.1 (the Zener diode), or 14.9 Volts shift (negative). The result is shown in the accompanying graphs. As explained on pages 24 and 25, proper operation of the display requires that the filament be negative.

VGG is zero Volts (system ground): in reference to VGG, the filament's 3.8 Volts AC is all negative; compared to VDISP it is positive.

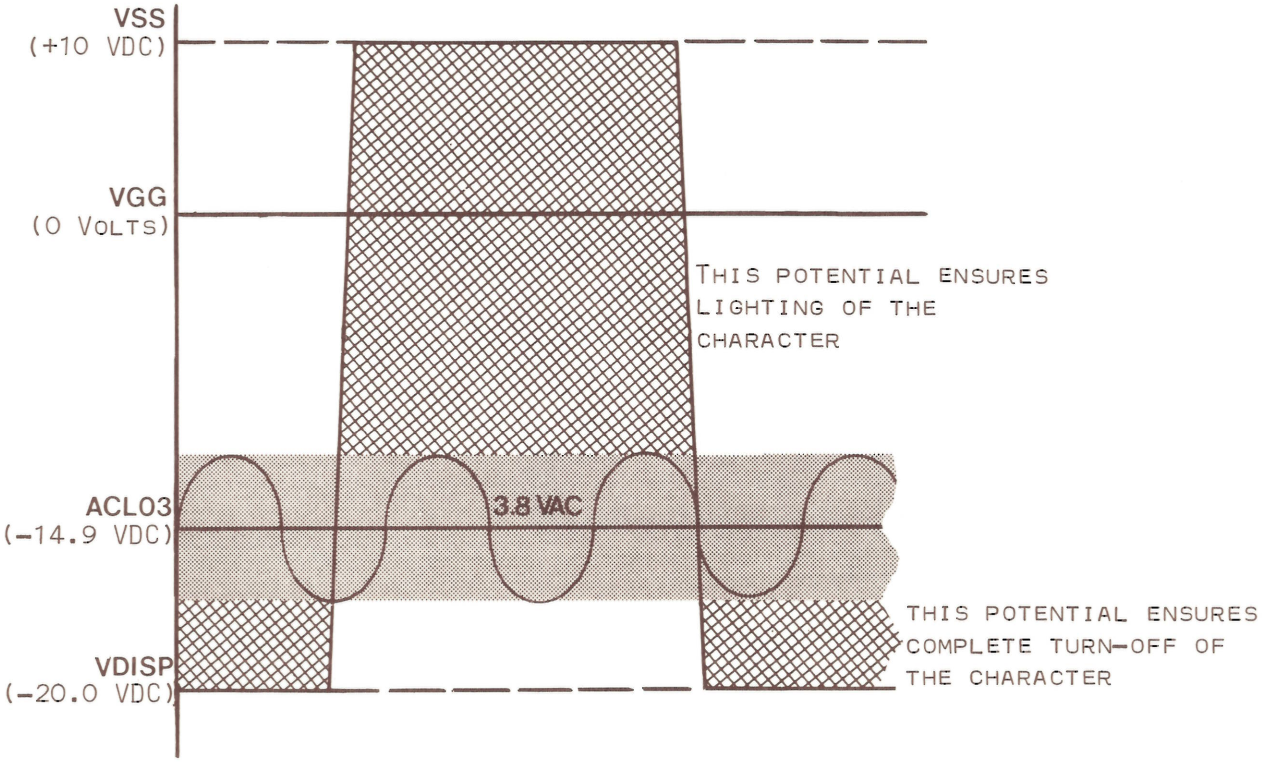






REVIEW THE FIGURES ON PAGE 25. WITH ALL OF THESE VOLTAGES PRESENT, THE SCAN OF A CHARACTER IS AS FOLLOWS: "REST" VOLTAGE IS VDISP FOR BOTH THE GRID AND THE SEGMENTS; ELECTRONS WILL NOT FLOW FROM THE FILAMENT TO THE SEGMENTS BECAUSE BOTH THE GRID AND THE SEGMENTS ARE "MORE NEGATIVE" THAN THE FILAMENT. THE CHARACTER REMAINS DARK. AS THE DISPLAY IS SCANNED, THE CHARACTER GRIDS ARE SEQUENTIALLY SWITCHED FROM VDISP TO VSS (THE OUTPUT VOLTAGE OF THE MOS DEVICES) AND BACK TO VDISP.

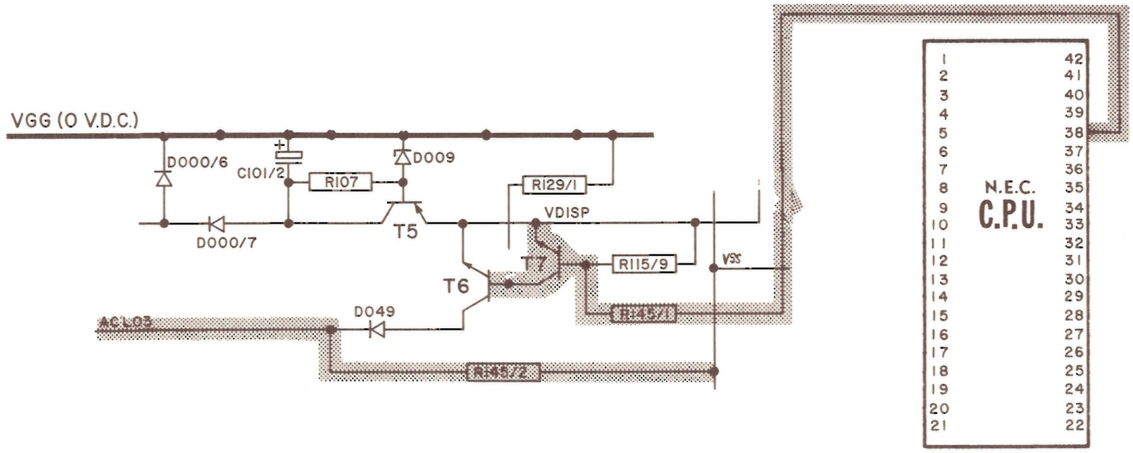
HOWEVER, IF A CHARACTER IS TO BE FORMED, THE SEGMENTS FOR THAT CHARACTER ARE ALSO SWITCHED FROM VDISP TO VSS. WHEN THIS HAPPENS THE GRID AND SEGMENTS ARE VERY POSITIVE IN REFERENCE TO THE FILAMENT, AND THE CHARACTER WILL LIGHT BECAUSE ELECTRONS CAN FLOW FROM THE FILAMENT TO THE SEGMENTS. IT IS TO MAKE THE CHARACTERS TURN OFF COMPLETELY THAT THE "REST" VOLTAGE (VDISP) IS MORE NEGATIVE THAN THE FILAMENT.


VSS
(+10 VDC)
VGG
(0 VOLTS)
THIS POTENTIAL ENSURES LIGHTING OF THE CHARACTER
ACL03
(-14.9 VDC)
3.8 VAC
THIS POTENTIAL ENSURES COMPLETE TURN-OFF OF THE CHARACTER
VDISP
(-20.0 VDC)

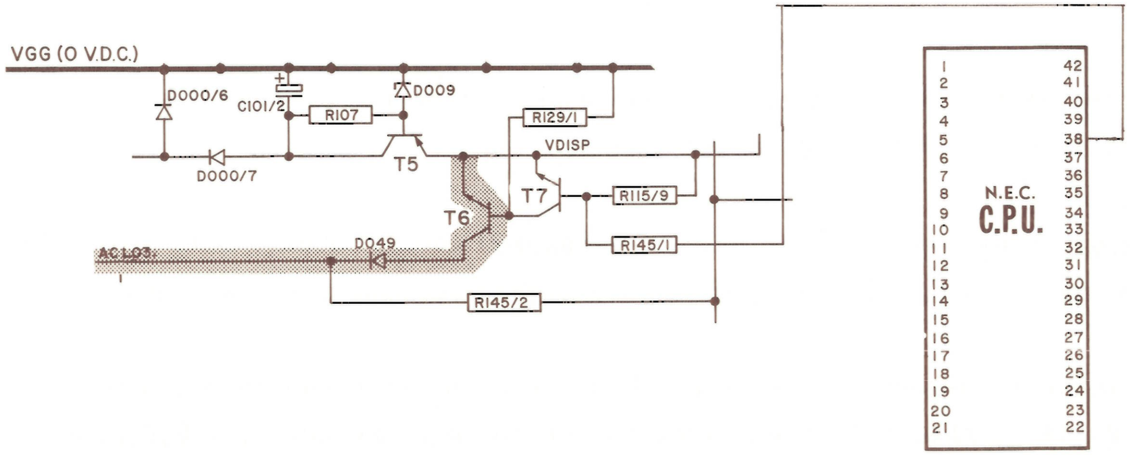
THE FOURTH CIRCUIT TURNS OFF THE DISPLAY WHILE THE CALCULATOR IS PRINTING. THIS PREVENTS ELECTRONIC "NOISE" IN THE DISPLAY, WHICH COULD BE DISTRACTING TO THE OPERATOR.

PIN 38 OF THE CPU IS THE PRINT ON-OFF SIGNAL; ITS RELATIONSHIP TO THE PRINTER HAS BEEN DISCUSSED ALREADY. PIN 38 ALSO CONTROLS THE CIRCUIT WHICH TURNS OFF THE DISPLAY DURING PRINTING, AS FOLLOWS:

AS PIN 38 GOES HIGH (TO VSS), THE +10 VDC WILL TURN ON TRANSISTOR T7; T7 WILL THEN TURN OFF TRANSISTOR T6. WHEN T6 IS OFF, VDISP IS NO LONGER PRESENT AT THE CENTER-TAP OF THE FILAMENT VOLTAGE. IN FACT, BECAUSE OF THE CONNECTION THROUGH RESISTOR R145/2, THE CENTER-TAP (ACL03) FLOATS UP TO VSS. THE RESULT IS THAT THE FILAMENT IS NO LONGER REFERENCED TO A NEGATIVE VOLTAGE, BUT RATHER TO A POSITIVE VOLTAGE. IF YOU FOLLOWED THE EXPLANATION OF THE DISPLAY, IT SHOULD BE CLEAR THAT THE DISPLAY CANNOT OPERATE IF THE FILAMENT IS REFERENCED TO A POSITIVE VOLTAGE.



AT THE CONCLUSION OF THE PRINT CYCLE, PIN 38 DROPS LOW AGAIN; T7 TURNS OFF, WHICH TURNS ON T6, ALLOWING THE NEGATIVE REFERENCE TO REACH THE CENTER-TAP ONCE MORE. THE DISPLAY OPERATES NORMALLY AGAIN.



R.E.D.
PROCEDURES

THIS PORTION OF THE TECHNICAL MANUAL CONTAINS ALL FACETS OF R.E.D. AND ALL REMAINING ELECTRONIC REPAIRS TO BE PERFORMED BY THE TECHNICIAN.

WITH THE INTRODUCTION OF LOGOS 43/45PD, A NEW CONCEPT HAS BEEN ADDED TO THE R.E.D. PROCEDURE. THE R.E.D. TECHNICIAN WILL NOT ONLY LOCATE AND REPLACE FAULTY DISCRETE COMPONENTS, BUT IC AND MOS DEVICES AS WELL. THIS IS POSSIBLE WITHOUT THE USE OF AN OSCILLOSCOPE BECAUSE OF AN EXTENSIVE FAULT-FINDING GUIDE, LOCATED IN THIS PORTION OF THE MANUAL. THIS FAULT-FINDING GUIDE WILL ALLOW THE TECHNICIAN TO REPLACE THE MOST PROBABLE FAULTY COMPONENT FIRST, ACCORDING TO THE MALFUNCTIONS OBSERVED BY THE TECHNICIAN.

AFTER PERFORMING THE GENERAL TEST AND A FAILURE OCCURS, IT IS ALWAYS ADVISABLE TO CHECK THE VOLTAGES VCF, VSS, VPR AND VDISP AS ON PAGES 28 AND 29.
FAULT IS FOUND IN ONE OF THESE, THEN CONSULT THE PORTION OF THE FAULT-FINDING GUIDE PERTAINING TO THE POWER SUPPLY, POWER-ON INITIALIZE AND MOTOR CIRCUITS.

WHEN THE PRINT IS FAULTY ALWAYS CHECK THE ADJUSTMENTS OF THE PRINTER AND BE SURE THEY ARE CORRECT BEFORE PROCEEDING TO THE ELECTRONIC FAULT-FINDING GUIDE. THESE ADJUSTMENTS ARE COVERED ON PAGES 19 THROUGH 23.

IF ALL OF THE POWER CIRCUITS ARE WITHIN THE PRESCRIBED LIMITS, THEN PROCEED TO THE PORTION OF THE FAULT-FINDING GUIDE PERTAINING TO THE MOS AND IC DEVICES.

APPROACH

1. EXAMINE THE BOARD FOR ANY OBVIOUS DEFECTS SUCH AS BROKEN COMPONENTS OR COLD SOLDER JOINTS OR BURNT OR DISCOLORED DEVICES OR COMPONENTS.

2. AFTER PRELIMINARY OBSERVATION, INSTALL EXTENSION CABLES (P 42). CONNECT TO THE E.C.U. AND A TEST MACHINE, AND FOLLOW THE DIAGNOSTIC PROCEDURE ON PAGE 26.

3. IF NO FAILURE IS OBSERVED AFTER FOLLOWING THE DIAGNOSTIC PROCEDURE, REPEAT THE PROCEDURE. IF NO FAILURE OCCURS AFTER THE SECOND PERFORMANCE, THE E.C.U. MUST BE CONSIDERED GOOD, AND RETURNED TO STOCK.

POWER SUPPLY FAULTS: **VCF** (+22 TO +38 VDC)

DEFECT	PROBABLE CAUSE
VCF IS 0 VDC	NO AC LINE VOLTAGE TO TRANSFORMER; FUSE BLOWN; TRANSFORMER FAULTY; LM342/10 FAULTY.
VCF LESS THAN +22 VDC, LM342/10 IS HOT	LM342/10 FAULTY; SHORT BETWEEN VSS AND VGG.
VCF LESS THAN +22 VDC, LM342/10 IS COLD	TRANSFORMER FAULTY; RECTIFIER DIODE(S) D000/1, D000/2, D000/3 OR D000/4 FAULTY.

POWER SUPPLY FAULTS: **VSS** (+10 VDC)

DEFECT	PROBABLE CAUSE
VSS IS 0 TO +7 VDC	LM342/10 FAULTY; SHORT BETWEEN VSS AND VGG.
VSS MORE THAN +12 VDC	LM342/10 FAULTY.

POWER SUPPLY FAULTS: **P.O.I.** POWER-ON INITIALIZE (+10 VDC)

DEFECT	PROBABLE CAUSE
P.O.I. IS +10 VDC (T1 READS +10 VDC AT COLLECTOR WITH MACHINE ON; SHOULD READ 0 VDC)	TRANSISTOR T1 FAULTY; DIODE D029 OPEN; CAPACITOR C203 SHORTED.

OTHER POWER SUPPLY FAULTS

DEFECT	PROBABLE CAUSE
FUSE BLOWS FREQUENTLY	RECTIFIER DIODE(S) D000/1, D000/2, D000/3 OR D000/4 FAULTY; SHORT BETWEEN VSS AND VGG; SHORT BETWEEN VPR AND VGG; SHORT BETWEEN VCF AND VGG.
TRANSFORMER MAKES EXCESSIVE NOISE	RECTIFIER DIODE(S) D000/1, D000/2, D000/3 OR D000/4 SHORTED; LM342/10 FAULTY.

MOTOR CIRCUIT FAULTS: **VPR** (+18 VDC)

DURING THE FAULT ANALYSIS, IF THE TECHNICIAN DETERMINES THAT THE FAULT IS IN THE MOTOR CIRCUIT, FIRST RE-CHECK VSS (+10 VDC) TO BE CERTAIN THAT THE MOS DEVICES ARE RECEIVING THE REQUIRED VOLTAGE TO ACTIVATE THE MOTOR CIRCUIT.

THE MOTOR CIRCUIT IS TURNED ON AND OFF BY THE CPU MOS DEVICE; THUS IT IS LOGICAL TO CHECK ITS OUTPUT FIRST. IF ITS OUTPUT IS CORRECT PER THE FOLLOWING TABLE, THEN THE OUTPUT OF THE IC DRIVERS SHOULD BE CHECKED. IF THIS IS CORRECT, THEN THE FAULT IS IN THE DISCRETE CIRCUITRY OF THE MOTOR CIRCUIT.

TABLE OF MOTOR CIRCUIT FAULTS

STEP *	SIGNAL TO BE CHECKED	PROBABLE FAULTY COMPONENT	LOCATION; PIN OR LEAD	CORRECT VOLTAGE OF SIGNAL	
				PRINTING	AT REST
1	PRINT ON–OFF	CPU MOS	PIN 38	+10 VDC	0 VDC
2	PRINT ON–OFF	2003/2	PIN 7	+10 VDC	0 VDC
3	MOTNP	2003/2	PIN 10	0 VDC	+34 VDC
4	MOTN	2003/2	PINS 11, 12	+18 VDC	0 VDC
5	VCF	T4	EMITTER	+30 VDC	+34 VDC
6	--	T4	COLLECTOR	+30 VDC	0 VDC
7	--	T4	BASE	+30 VDC	+34 VDC

* FOLLOW THESE STEPS IN THE SEQUENCE PRESENTED.

OTHER MOTOR CIRCUIT FAULTS

DEFECT	PROBABLE CAUSE
VPR IS HIGH	DIODE D019 OPEN; TRANSISTOR T3 FAULTY.
VPR IS LOW	DIODE D019 SHORTED; RESISTOR(S) R145, R137, R129 OR R124 SHORTED; BDX33 FAULTY.

ELECTRONIC DISPLAY FAULTS

C101/1 OPEN	DISPLAY WEAK
C101/2 OPEN	DISPLAY FLICKERS
D000/6 OPEN	DISPLAY WEAK
D000/7 OPEN	DISPLAY WEAK
D009 OPEN	VDISP = -30 VDC; WILL CAUSE QUICK FAILURE
D049 OPEN	NO DISPLAY
D000/6 SHORT	DISPLAY WEAK
D000/7 SHORT	DISPLAY WEAK
D009 SHORT	DISPLAY WEAK
D049 SHORT	DISPLAY FLICKERS
FIL4/5 OPEN*	NO DISPLAY

* CONTINUITY CHECK OF FIL4 AND FIL5 ON TUBE SHOULD READ 25 TO 35 OHMS.

CPU MOS DEVICE FAULTS

PIN	FAULT
1	NO EFFECT
2	NON-PRINT, ACC, PROG FAIL
3	7,8,9,0, 00, 000, ⊙, CE:CA KEYS; DECIMAL @ H, D FAIL
4	△, X, ÷, %, GT, CNT, T2, S2 KEYS; DECIMAL @ +, 4, 6 FAIL
5	=, +1, -1, T1, S1, R, GM, +2, -2 KEYS; DECIMAL @ 2, 6, H FAIL
6	1, 2, 3, 4, 5, 6, ⊖ KEYS; DECIMAL @ +, FL FAIL
7	NO PRINT IN 5TH AND 6TH POSITIONS
8	NO PRINT IN 7TH AND 8TH POSITIONS
9	NO DP SEGMENTS; NO PRINT IN 9TH AND 10TH POSITIONS
10	NO EFFECT
11	NO EFFECT
12	NO EFFECT
13	ALL FUNCTIONS CONFUSED, INTERMITTENT DISPLAY
14	NO G SEGMENTS, NO PRINT IN 11TH AND 12TH POSITIONS
15	NO F SEGMENTS, NO PRINT IN 13TH AND 14TH POSITIONS
16	NO E SEGMENTS, NO PRINT IN 15TH AND 16TH POSITIONS
17	NO D SEGMENTS, NO PRINT IN 17TH AND 18TH POSITIONS
18	NO C SEGMENTS, NO PRINT IN 19TH AND 20TH POSITIONS
19	NO B SEGMENTS, NO PRINT IN 3RD AND 4TH POSITIONS
20	NO A SEGMENTS, NO PRINT IN 1ST AND 2ND POSITIONS
21	NO EFFECT
22	NO DISPLAY IN 1ST POSITION; △, =, 7 KEYS FAIL
23	NO DISPLAY IN 2ND POSITION; 1, 8, X, +1 KEYS FAIL
24	NO DISPLAY IN 3RD POSITION; 2, 9, ÷, -1 KEYS FAIL
25	NO DISPLAY IN 4TH POSITION; 3, 0, %, T1 KEYS FAIL; EXTRA CHARACTER IN 7TH POSITION OF DISPLAY
26	NO DISPLAY IN 5TH POSITION; 4, 00, S1, GT KEYS FAIL; PRINT/NON-PRINT SELECTOR FAILS IN NON-PRINT POSITION
27	NO DISPLAY IN 6TH POSITION; 5, 000, R, CNT KEYS FAIL; (L45PD ONLY) PROG POSITION FAILS; CE:CA DOES NOT CLEAR
28	NO DISPLAY IN 7TH POSITION; 6, ⊙, #, GM KEYS FAIL; ACC (ACCUMULATE) POSITION FAILS
29	NO DISPLAY IN 8TH POSITION; ⊖, +2, T2, CE:CA KEYS FAIL; R/0 @ 9 POSITION FAILS
30	NO DISPLAY IN 9TH POSITION; -2, S2 KEYS FAIL; R/0 @ 5 FAILS
31	NO DISPLAY IN 10TH POSITION; ALL DECIMAL POSITIONS = ZERO
32	NO DISPLAY IN 11TH POSITION
33	NO DISPLAY IN 12TH POSITION
34	NO DISPLAY IN 13TH POSITION
35	PRINTER RUNS CONTINUOUSLY, NO PRINT
36	PRINTER RUNS CONTINUOUSLY, NO PRINT
37	PRINTER RUNS CONTINUOUSLY, NO PRINT
38	MACHINE DEAD
39	MACHINE DEAD
40	ENTIRE DISPLAY LIT; MACHINE MAY PRINT NONSENSE DOTS
41	MACHINE DEAD
42	PRINTER RUNS CONTINUOUSLY, NO PRINT

COLD SOLDER JOINTS

OCCURING AT JUMPER WIRES
(REFER TO E.C.U. LAYOUT)

J6	PRINTER RUNS CONTINUOUSLY, NO PRINT
J7	NO PRINT IN 7TH AND 8TH POSITIONS
J8	NO PRINT IN 5TH AND 6TH POSITIONS
J9	MACHINE DEAD (PRINTER MAY MOVE SLIGHTLY)
J10	NO DISPLAY IN 5TH POSITION
J11	NO DISPLAY IN 2ND POSITION
J12	NO DISPLAY IN 5TH POSITION
J13	NO DISPLAY IN 6TH POSITION
J14	NO DISPLAY IN 4TH POSITION
J15	NO DISPLAY IN 3RD POSITION
J16	NO DISPLAY IN 1ST POSITION
J17	NO E SEGMENTS IN ANY POSITION
J18	NO F SEGMENTS IN ANY POSITION
J19	PRINTER RUNS CONTINUOUSLY, NO PRINT
J21	PRINTER RUNS CONTINUOUSLY, NO PRINT
J22	NO DISPLAY IN 12TH POSITION
J23	NO DISPLAY IN 13TH POSITION
J24	MACHINE DEAD
J25	PRINTER RUNS CONTINUOUSLY, NO PRINT
J26	MACHINE DEAD
J28	NO G SEGMENTS IN ANY POSITION
J29	NO DISPLAY IN 11TH POSITION
J30	NO G SEGMENTS IN ANY POSITION
J31	NO D SEGMENTS IN ANY POSITION
J32	MACHINE DEAD
J33	MACHINE DEAD
J34	NO DECIMAL POINT IN ANY POSITION
J35	PRINTER RUNS CONTINUOUSLY, NO PRINT
J36	PRINTER RUNS CONTINUOUSLY, NO PRINT
J37	NO DISPLAY IN 7TH POSITION
J39	MACHINE DEAD
J40	MACHINE DEAD
J41	NO B SEGMENTS IN ANY POSITION
J42	MACHINE DEAD
J43	NO PRINT IN 3RD AND 4TH POSITIONS
J44	MACHINE DEAD
J45	PRINTER RUNS CONTINUOUSLY, NO PRINT
J46	NO PRINT IN 17TH AND 18TH POSITIONS
J47	NO PRINT IN 1ST AND 2ND POSITIONS
J48	NO PRINT IN 13TH AND 14TH POSITIONS
J49	PRINTER RUNS CONTINUOUSLY, NO PRINT
J50	NO DISPLAY IN ANY POSITION (FILAMENT)
J51	NO PRINT IN 7TH AND 8TH POSITIONS
J52	NO PRINT IN 5TH AND 6TH POSITIONS
J53	NO EFFECT
J54	MACHINE DEAD
J55	MACHINE DEAD
J56	PRINTER RUNS TOO FAST, PRINT QUALITY POOR
J57	NO EFFECT (GROUND CONTACT POINT)

GENERAL TEST
LOGOS 43

Begin Test with selectors set at: PRINT, ACC, R/O =0, DEC = +

machine ON	0.00 C	
		linespace
818181818181 +1	8 181 818 181.81 +1	
+1	8 181 818 181.81 E1	
	ERROR	overflow
		linespace
CE:CA +1	8 181 818 181.81 E1	
	ERROR	overflow
		linespace
CE:CA T1	8 181 818 181.81 ᵀ₊1	auto accum
		linespace
70707070707 +1	707 070 707.07 +1	
T1	707 070 707.07 ᵀ₊1	auto accum
		linespace
GT S1	8 888 888 888.88 S3	
		linespace
÷	8 888 888 888.88 ÷	
9 =	0.09 =	
	98 765 432 098.6 E	
	ERROR	overflow
		linespace
CE:CA GT T1	8 888 888 888.88 T3	no accum
		linespace
123.456. GT 789 +1	123.456789 +1	GT, 2nd dec. ignored
T1	123.45 ᵀ₊1	auto accum
	↓	result rounded down
GT T1	123.45 T3	
		linespace
△	123.45 △	
11111 =	111.11 =	
	-12.34 △ᵀ₊	auto accum
	-9.99 △%	
	↓	result rounded down
.1 R	0.1 R	
		linespace
R/O = 9, DEC = 2 145 ÷	145.00 ÷	
-12 =	-12.00 =	
	-12.09 T	normal roundoff
	-12.10 Rᵀ₊	parametric round
	↑R	result rounded up
R/O = 5 1 ÷	1.00 ÷	
9 =	9.00 =	
	0.11 T	normal roundoff
	0.10 Rᵀ₊	parametric round
	↓R	result rounded down
ACC=off, DEC = D CE:CA CE:CA	0 C	reset
		linespace
1.1.1977 +1	1.01.1977 D	
358 =	DAYS	
	358 +	
	12.25.1977 D2	
	SUN 7	
		linespace

DEC = H	7.29	+1	7.29.00 TI	
	12.01	=	12.01.00 TO	
			4.32.00 +1	
				linespace
	12.30	+1	12.30.00 TI	
	16.1	=	16.01.00 TO	
			3.31.00 +1	
				linespace
		T1	8.03.00 T1	
				linespace
DEC = FL, ACC = ON	.5	R	0.5 R	
				linespace
	4	÷	4 ÷	
	7	=	7 =	
			0.57142857142 T+	auto accum
				linespace
		+1	0.57142857142 +1	
DEC = 6		T1	0.571429 T1	
			0.500000 RT+	rounded result
			-0.071429 AD	difference
			↓	result rounded down
DEC = 4, R/O = 9	GT	T1	1.0715 T3	
			1.5000 RT	rounded result
			0.4285 AD	difference
			↑	result rounded up
DEC = 2		R	0.5 R	recalled
				linespace
	27	GM	27.00 M	
	161	=	161.00 =	
			220.55 T	
			221.00 RT	
			↑R	result rounded up
		△	221.00 △	
	225	=	225.00 =	
			4.00 △T+	auto accum
			1.81 △%	
			↑	result rounded up
	GT	S1	4.00 S3	
				linespace
		X	4.00 ×	
		÷	4.00 ÷	
		%	4.00 %	
			400.00 T	
			400.00 RT+	
				linespace
		X	400.00 ×	
		÷	400.00 ÷	
		%	400.00 %	
			40 000.00 T	
			40 000.00 RT+	
				linespace

123	+1	123.00 +1	
	+1	123.00 +1	
	+1	123.00 +1	
	T1	369.00 T1	
		369.00 R↓	rounded total
		0.00 AD	
			linespace
	CNT	003 CNT 1	
	CNT	123.00 AM	auto average
			linespace
GT	T1	40 773.00 T3	
		40 773.00 RT	rounded total
		0.00 AD	
			linespace
	CNT	004 CNT 3	
	CNT	10 193.25 AM	
			linespace
* PROG	T/A	WRITE A	
	-/K	K	
75	GM	75.00 M	
1 00	=	100.00 =	
		400.00 T	
		400.00 RT	rounded total
			linespace
	S/B	WRITE B	
	X	400.00 ×	
	-/K	K	
-15	%	IN USE T3	
		-15.00 %	
		-60.00 T	
		340.00 T	
		340.00 RT	rounded total
			linespace
	+1	340.00 +1	
	T/A	RUN A	
	+/ST	75.00 M	
79	+/ST	79.00 =	
		316.00 T	
		316.00 RT	rounded total
			linespace
	S/B	RUN B	
	+/ST	316.00 ×	
		-15.00 %	
		-47.40 T	
		268.60 T	
		269.00 RT	rounded total
		↑R	result rounded up
		269.00 +1	
CE:CA	CE:CA	0.00 C	
			linespace

* - Shaded area L45PD ONLY.

T/A	RUN A	
+/ST	75.00 M	
99 +/ST	99.00 =	
	396.00 T	
		linespace
S/B	RUN B	
+/ST	396.00 ×	
	-15.00 %	
	-59.40 T	
	336.60 T	
		linespace
	336.60 +1	
T1	336.60 T1	
		linespace
CNT	001 CNT 1	
CNT	336.60 AM	
		linespace

Notice: (L45PD models) CE:CA does not erase the sequence in PROG mode; only previous totals, parametric rounding, etc., are erased. To clear the sequence, you must switch the ACC selector to the Off position and depress CE:CA twice.

ACC = Off CE:CA CE:CA	0.00 C	
		linespace
X	×	
=	=	2-key sequence
		linespace
23 +1	23.00 ×	
56 +1	56.00 =	
	1 288.00 T	
		linespace
14 +1	14.00 ×	
25 +1	25.00 =	
	350.00 T	
		linespace
+1	350.00 ×	
+1	350.00 =	
	122 500.00 T	
		linespace
PRINT=Off, DEC=0 456 +1	**456**	display only
+1	**207936**	display only
+2	**207936**	display only
+2	**415872**	display only
T2	**415872**	display only
T1	**0**	display only

END OF TEST